Exploring the possibility of the insurance industry as a solar water heater driver in South Africa

by

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Abstract

South Africa is facing an energy crisis on two levels; the existing capacity to supply electricity is unable to support future growth in demand, and the electricity being produced comes mostly from coal-fired power stations with associated emission problems. The South African government has a target for renewable energy to service 23% of the country's energy consumption by 2013. This could potentially be realised through achievement of another government target, the installation of one million Solar Water Heaters (SWHs).

On a technical level, Solar Water Heaters (SWHs) represent a completely viable renewable energy alternative for South Africa. It is an established and proven technology which has the potential to have a big impact on the country's electricity capacity problems. SWHs can be used in a variety of applications from industry to households. Most of the hot water in South African homes is heated by electric resistance heating in standard electric water heaters and there are no technical obstacles to replacing most of these with SWHs, thereby delivering a saving of up to 70% of the water heating energy bill. Water heating currently accounts for 40% of domestic electricity consumption within a residential sector that uses 20-30% of the national supply. At the macro-scale, the roll out of SWH programmes is completely scalable.

The benefits of SWH installation accrue to the consumer in the form of a financial saving in the long-term and to society in the form of reduced emissions. Awareness of the benefits is growing amongst the general public, commercial institutions and in government. Sales are starting to pick up due to, amongst other reasons, electricity price hikes and government subsidies for SWH installations offered through the national electricity supply company, Eskom. A national building regulation enforcing energy-efficient water heating in new buildings has been drafted and is expected to be in place by mid 2011.

The rate of change from electric to solar water heaters remains disappointingly slow, however. The SWH industry in South Africa accounts for less than 10% of total hot water solutions sold. This study sought to establish the opportunities as well as possible barriers for the creation of SWH programmes within the insurance sector. Close to 50% of all standard electric water heaters installed in South Africa are procured and installed via the insurance industry due to the failure of units that have endured beyond the manufacturer's guarantee period. This presents an opportunity for interventions that encourage policyholders to change to SWHs. Such interventions, if successful, would dramatically speed up the roll out of SWHs in South Africa. In addition the

study sought to determine the barriers to the uptake of SWHs by policyholders in the case of the two insurance companies that currently have SWH programmes in operation.

Data was collected through interviews with representatives in the insurance industry and a range of SWH industry stakeholders and consumers. The literature review focused on SWH policies and regulations and corporate and marketing theories. The material on transition in socio-technological systems proved especially useful in understanding the complex dynamics of the study topic.

The conclusion drawn from the research is that the South African insurance industry has the capacity and opportunity to drive the penetration of SWH technology. The opportunity is, however not being exploited to anywhere near its potential. The entire system is geared towards providing a particular 'business-as-usual' solution. Analysis conducted in this study confirms that the system is in a "locked-in" state and extremely resistant to change. If the opportunity is to be acted on, to supplant the dominant technology for water heating installed by the insurance industry with what is currently a niche technology (SWHs), an external landscape shock is almost certainly needed. This shock to the system could be aided by interventions that target a change in the current system's logic. The study provides some suggestions in this regard.

Samevatting

Suid-Afrika staar 'n energie krisis in die gesig. Aan die een kant is die bestaande elektrisiteitsvoorsiening nie genoeg om plek te maak vir die toekomstige vraag na elektrisiteit nie en aan die ander kant word meeste van Suid-Afrika se elektrisiteit opgewek deur steenkool-aangedrewe kragstasies met gevolglike probleme as gevolg van vrylating van kweekhuis-gasse. Die Suid-Afrikaanse regering het 'n teiken vir hernubare energie om 23% op te maak van die land se totale energie verbruik teen 2013. Hierdie teiken sou potensieel bereik kon word deur die bereiking van 'n ander van die land se teikens, naamlik die instalering van een miljoen sonverhitters.

Op 'n tegniese vlak verteenwoordig sonverhitters 'n lewensvatbare hernubare energie alternatief vir Suid-Afrika. Dit is 'n beproefde tegnologie wat die potensiaal het om 'n groot impak te hê op die elektrisiteit kapasiteitsprobleme van die land. Sonverhitters kan 'n verskeidenheid van warm water behoeftes bevredig, van groot industrieë tot tuisverbruik. Meeste warm water in Suid-Afrikaanse huise word verhit deur standaard elektriese geisers. Daar bestaan geen tegniese hindernisse om hierdie geisers deur sonverhitters te vervang en tot 70% van die water verhittings energie rekening

te bespaar nie. Water verhitting maak tans 40% van die totale huishoudelike elektrisiteits verbruik op. Die huishoudelike verbruik is 20-30% van die nasionale verbruik en selfs hoer gedurende piek. Op die makro skaal is die uitrol van sonverhitters heeltemal skaleerbaar.

Die voordele van die installering van sonverhitters val die verbruiker toe in die vorm van finansiele besparing oor die lang termyn en vir die samelewing as geheel in die vorm van emissie besparings. Bewustheid van die voordele is aan die groei by die algemene publiek, kommersiele instansies en by die regering. Verkope het begin optel as gevolg van onder andere die elektrisiteits prysverhoging en die staatssubsidies vir sonverhitters aangebied via die nasionale elektrisiteits toevoer maatskappy, Eskom. A nasionale bouregulasie wat enegie doeltreffende waterverhitting sal afdwing op nuwe geboue is reeds opgestel en dit word verwag dat hierdie regulasie in plek sal wees teen middel 2011.

Die koers van verandering van elektriese water verhitters na sonkrag bly egter teleurstellend laag. Die sonverhittings industrie in Suid-Afrika maak minder as 10% van die totale water verhittings mark uit. Hierdie studie het beoog om die geleenthede sowel as die moontlike versperrings tot die skepping van sonverhittings programme in die versekerings bedryf uit te wys. Die versekerings bedryf koop en installeer ongeveeer 50% van alle standaard elektriese geisers in Suid-Afrika as gevolg van elektriese geisers wat breek na die vervaardiger se waarborg verval het . As gevolg hiervan bestaan daar ‘n geleentheid vir intervensies wat polishouers aanmoedig om te verander na sonverhitters. Sulke intervensies, indien suksesvol, het die potensiaal om die uitrol van sonverhitters in die land dramaties te versnel. Verder het hierdie studie beoog om die versperrings tot die opname van sonverhitters uit te wys by twee versekerings maatskappye in Suid-Afrika wat wel sonverhittings programme het.

Data is versamel deur onderhoude met verteenwoordigers van die versekeringsbedryf en ‘n reeks sonverhitting industrie belanghebbendes en verbruikers. Die literatuurstudie het gefokus op sonverhittings beleid en regulasies en korporatiese en bemarkings teorie. ‘n Literatuurstudie in oorgang in sosio-tegnologiese sisteme was veral nuttig om die komplekse dinamika van die sisteem te verstaan.

Die gevolgtrekking van hierdie studie is dat die Suid-Afrikaanse versekeringsbedryf wel die kapasiteit en geleentleid het om die penetrasie van sonverhittings tegnologie te dryf. Hierdie geleentheid word egter nie gebruik tot sy volle potensiaal nie. Die ganse sisteem is gerat om ‘n spesifieke tegnologie op ‘n sekere manier te verskaf. Analise in hierdie studie bevestig dat die sisteem in ‘n geslote staat is en daar is uiterste teenkanting tot verandering. Indien hierdie

geleentheid om die dominate tegnologie vir waterverhitting geinstaleer deur die versekerings bedryf te verplaas met wat op die oomblik nog ‘n niche tegnologie is (sonverhitters), is ‘n eksterne landskap skok nodig. Hierdie skok tot die sisteem kan aangehelp word deur intervensies wat ‘n verandering in die huidige sisteem logika teiken. Hierdie studie bied ‘n paar voorstelle in hierdie verband.

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List of Acronyms and Abbreviations

CDM	Clean development mechanism
CEF	Central Energy Fund
CER	Certified emission reductions
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CSR	Corporate social responsibility
DBSA	Development Bank of South Africa
DE	Department: Energy
DPE	Department: Public Enterprises
DSM	Demand side management
EDC	Energy Development Corporation
EEDSM	Energy efficiency and demand side management
ESCO	Energy Services Company
FNOL	First notice of loss (insurance claims)
GBCSA	Green building council of South Africa
GDP	Gross domestic product
GHG	Greenhouse gas
GIS	Geographic Information System
GRI	Global Reporting Initiative
GW	Gigawatt
GWh	Gigawatt hour
GWth	Gigawatt thermal
IRR	Internal rate of return
IWG	Insurance Working Group of the United Nations Environment Programme Finance Initiative (UNEP FI)

JSE	Johannesburg stock exchange
KW	Kilowatt
KWh	Kilowatt hour
KWth	Kilowatt thermal
MW	Megawatt
MWh	Megawatt hour
MWth	Megawatt thermal
MYPD	Multiyear price determination
NBI	National Business Initiative
NBR	National Building Regulation
NEEA	National Energy Efficiency Agency
NERSA	National Energy Regulator of South Africa
NGO	Nongovernmental organisation
NIRP	National Integrated Resource Plan
NMBM	Nelson Mandela Bay Municipality
NRCS	National Regulator for Compulsory Specifications
pCDM	Programmatic CDM
PIRB	Plumbing Industry Regulation Board
ROI	Return on investment
SABS	South African Bureau of Standards
SANS	South African national standard
SESSA	Sustainable Energy Society of South Africa
SolTrain	Southern African Solar Thermal Training & Demonstration Initiative
SOP	Standard Offer Programme
SWH(s)	Solar water heater(s)
SWHD	Solar water heater division of the Sustainable Energy Society of South Africa (SESSA)

tCO_2e	Ton carbon dioxide equivalent
UN	United Nations
UNEP	United Nations Environment Programme
UNEP FI	United Nations Environment Programme Finance Initiative
VER	Verified emission reductions
WSSD	World Summit On Sustainable Development

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Chapter One: Background

"No problem can be solved from the same consciousness that created it.

We have to learn to see the world anew". Albert Einstein.

We all use energy daily. To merely be alive requires energy. We need energy to produce our food, our clothes and our houses. We also need energy to transport all of these to where we can use them. Modern western societies tend to use more energy per capita and this energy often comes from less sustainable sources. The energy used in a society has historically come from the most easily accessed sources. Worldwide, coal and oil are the dominant sources of energy at present; both are fossil fuels. In addition to the emission problems associated with the burning of fossil fuels, they are exhaustible. The world is currently in the grip of an energy crisis as a result of this.

Renewable energy sources are gaining popularity due to both the sustainability of their use and the lower impact on the environment. Technologies have been developed to make use of solar, wind, hydro, oceanic and geothermal energy. These products, however, still have a small worldwide penetration into the energy market.

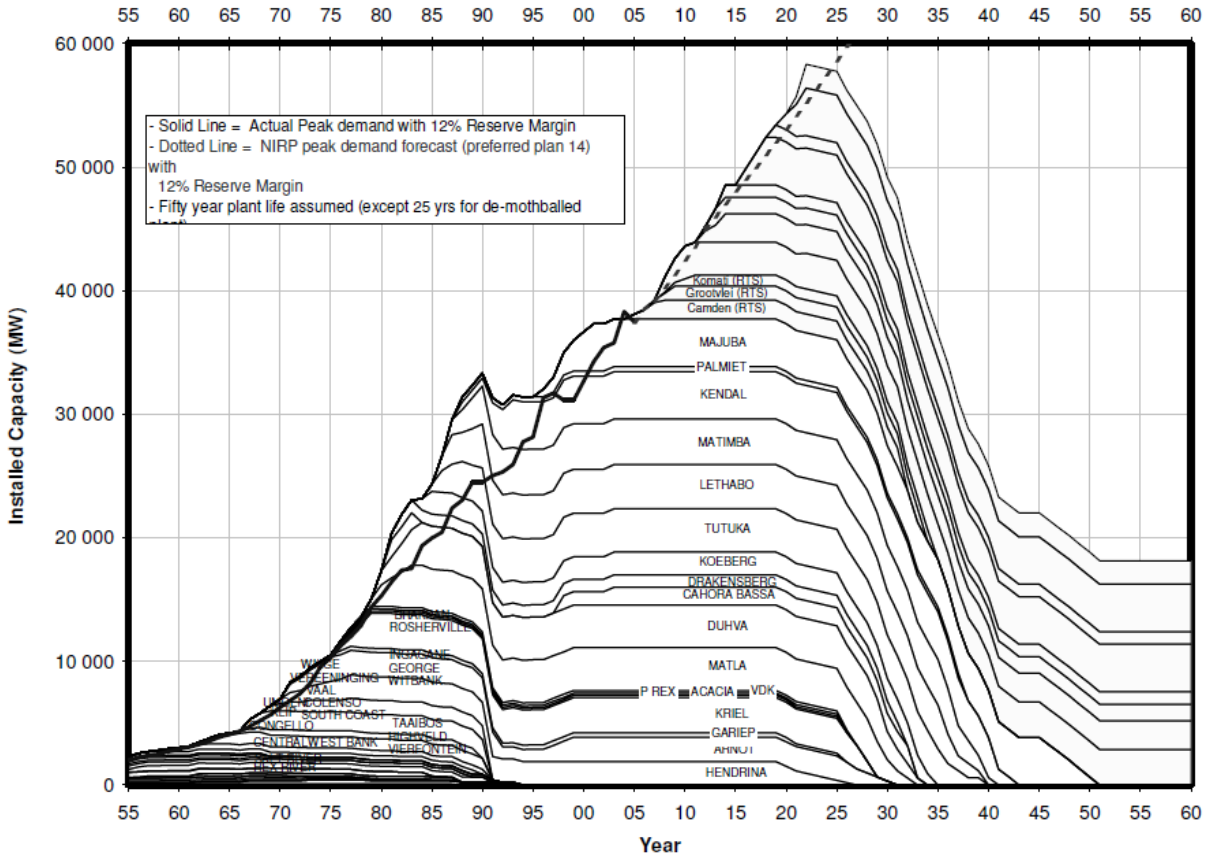
1.1 Justifying solar water heating

South Africa, like the rest of the world, is facing an electricity crisis. The crisis faced is on two levels; we have severe electricity shortages, and the electricity which is produced comes mostly from coal-fired power stations with associated emission problems. Because coal is a fossil fuel, not only will it eventually run out but, burning it releases carbon dioxide (CO_2) and other greenhouse gases (GHGs). This adds to the pollution of an already overburdened atmosphere and, in so doing, exacerbates climate change.

Figure 1 shows the country's actual peak demand and peak demand forecast versus installed capacity and forecasted installed capacity requirement for 1955 to 2060. Despite the fact that an electricity supply shortage was forecast as early as 2003, limited new capacity has been built or planned in recent years. The economic crisis of 2009 resulted in a lowering of electricity demand, thereby easing the load (Creamer 2010b). However, because economic growth has yet to be

decoupled from energy use, it is projected that demand will grow as soon as the economy picks up again. Medupi power station, projected to come on line in about 2008 (Figure 1), will most probably only be commissioned in 2013. Its 4 800 MW capacity will relieve the pressure on the supply sector for a period but acting chairman of Eskom, Mpho Makwana as quoted by Flak (2010) projects that even more capacity will be needed by 2018 to meet the fast-rising demand.

Figure 1: Eskom historic and planned system expansion



Source: Eskom in Steyn 2006

In the past, South Africa's energy policy has aimed to ensure that an adequate supply is provided in response to demand. More recently however, through Eskom's Demand Side Management (DSM) programme, efforts have been made to reduce demand.

South Africa is dependent on coal for almost all of its electricity needs. Eskom produces over 90% of its electricity from coal-fired power stations (Ministry of Public Enterprises 2004). South Africa is

one of the biggest emitters of total greenhouse gas in the world (Environment Statistics 2010; Baumert, Hertzog & Pershing 2005). Over 70% of the country's emissions come from the energy sector (Department of Environmental Affairs 2010). South Africa is also one of the top fifty GHG emitters per capita in the world (Baumert *et al* 2005).

To overcome the dual problems of supply shortage and emissions in the electricity sector, the South African government has set a target for renewable energy to contribute 10 000 gigawatt hours (GWh) of final energy consumption by 2013. One of the programmes which could contribute to the achievement of this target is the subsidy scheme for Solar Water Heaters (SWHs).

The industrial sector generates 56% of electricity demand in South Africa and 14% comes from the commercial and public services sector (IEA 2007). The residential sector accounts for 20% of electricity demand but, at peak times, this rises to over 30% (Holm 2005, Ijumba *et al* 2009). Total electricity consumed by the domestic sector in South Africa in 2007 was 41 213 GWh (IEA 2007).

Water heating represents about 40% of a household's electricity usage (Holm 2005) and about 30% of usage in a small- to medium-sized hotel (Jennings 2010). It imposes a heavy burden on the already stressed electricity generation and transmission infrastructure of the country because most water is heated with standard electric water heaters that use electrical heating elements. The situation is exacerbated because much of the heating occurs during peak electricity demand periods. Domestic water heating therefore has a significant impact on the electricity supply capacity of the country.

Holm (2005) has shown that, of the electricity used to heat water (which represents about 40% of a household's total electricity usage), about 70% can be saved by using a SWH. Most SWHs used in middle- and high-income households are typically not designed to satisfy 100% of a household's hot water needs; they have an electrical back-up element to cater for overcast days or when there is an unusually high demand for hot water. The activation of the back-up element can be minimised with correct use of a timer and behavioural changes such as showering instead of bathing, installing low-flow shower heads and washing clothes in cold water. A SWH could save the equivalent of between 150 and 400 KWh per month of transmitted electricity, or even more, depending on the household's hot water usage (Holm 2005). This great potential of SWHs to substantially reduce the demand for generation and transmission of electricity is under-utilised in South Africa.

The South African government has set a target for the installation of one million SWHs by the year 2014. Using an average saving of 200KWh per month, derived from Holms (2005) estimation cited

above, one million SWHs could potentially reduce electricity consumption by 2 300 gigawatt hours (GWh) per year. This equates to 23% of 10 000 GWh, the government's target for the renewable energy contribution to final energy consumption by 2013. There is, however, no clear strategy in place to achieve the objective of installing one million SWHs.

The per capita CO_2 emissions for 2007 in South Africa was 8.82 tons (UNstats 2010). Table 1 below shows the total estimated annual reduction in resource use and emissions associated with SWH use, assuming a 250 kWh electricity saving per month. The average annual reduction in emissions that could be achieved, per SWH, is 1.5 tons of coal and 2.5 tons of CO_2. The reduction in emissions associated with installation of one million SWHs would amount to 1.5 million tons of coal and 2.5 million tons of CO_2 every year.

Table 1: Annual associated reduction in resource use and emissions, per SWH, based on a 250 kWh electricity saving per month

Water usage	3 750ℓ
Coal usage	1.5 tons
Ash produced	390kg
Ash emitted	1 050g
SO_2 emitted	24 kg
NOX emissions	10.6 kg
CO_2 emissions	2.5 tons

Adapted from: Eskom 2000

A SWH typically consists of a heat collector, that makes use of solar radiation to heat up the water, and a storage unit for the hot water. The unit usually uses a back-up electric element. SWHs can be used in a wide variety of applications from small domestic units through medium-sized units for the hotel and catering industry, to large units mostly for preheating in any industry where heat is needed.

Most buildings are suitable for the use of SWHs. Where, occasionally, a building is not suited to use of a SWH, a water heater with an electric heat pump could be installed. This technology uses the ambient air temperature to heat up the water via a heat exchange. A heat pump is more energy efficient than an element for water heating but costs more and many units still use environmentally

destructive refrigerants. A heat pump would render slightly lower electricity savings for the homeowner than a SWH (Rankin & Eldik 2008).

If an electrical water heater uses 40% of the household electricity, and up to 70% of this could be saved by installing a SWH (Holm 2005), a saving of 11 540 GWh per year could be attained if all households in South Africa switched to SWHs(41 213 GWh x 40% x 70%). For illustrative purposes, without taking transmission losses into account, this translates to a significant 1 317 MW capacity reduction (11 540 GWh / 365 / 24). This calculation presumes elements of water heaters using electricity at any one point in time being evenly spread out. Calculating capacity reduction saving due to the installations of SWHs could be approached from a different angle. If 4.2 million water heaters are taken (DE 2009) and it is presumed that 70% of the elements of these are on during peak hours and the average size of the electric element is 3KW, the capacity needed for the water heaters is 8 820 MW (4 200 000 x 70% x 3KW), without taking transmission losses into account. Further reductions could be achieved by introducing SWHs to meet the hot water requirements of the commercial and industrial sectors.

Transmission losses in South Africa amount to 8.4% of total supply (IEA 2007). Because the water in a SWH is heated on site, the reduction in transmitted electricity is even greater due to the avoidance of transmission losses.

The Eskom SWH subsidy is a capital subsidy paid out at purchase and installation of an approved system. The subsidy amount was doubled in January 2010 and now ranges from R2 100 to R12 500 per SWH unit installed (Eskom Media Desk 2010). The subsidy amount is calculated on the efficiency of a specific SWH and thus the KWh electricity savings projected. About 700 subsidies were paid out in 2008 and about 1 600 in 2009 (De Bruyn 2010). It is estimated that about 1 500 subsidies were paid out in the first six months of 2010 (Motau 2010). It remains to be seen whether this is indicative of a higher uptake of SWHs or of more people applying for the subsidy. It is, however, clear that the number of subsidies paid is very small even in comparison to the number of SWHs installed per year.

Due to the slow uptake of the SWH subsidy, amongst other reasons, the South African Department of Energy (DE) has proposed a new financial instrument aimed at promoting SWHs. Referred to as the Standard Offer Programme (SOP), it will be rolled out either in place of, or in parallel with, the existing Eskom-run subsidy programme. The date for commencement was originally set at 23 September 2010.

According to the DE, the SOP is:

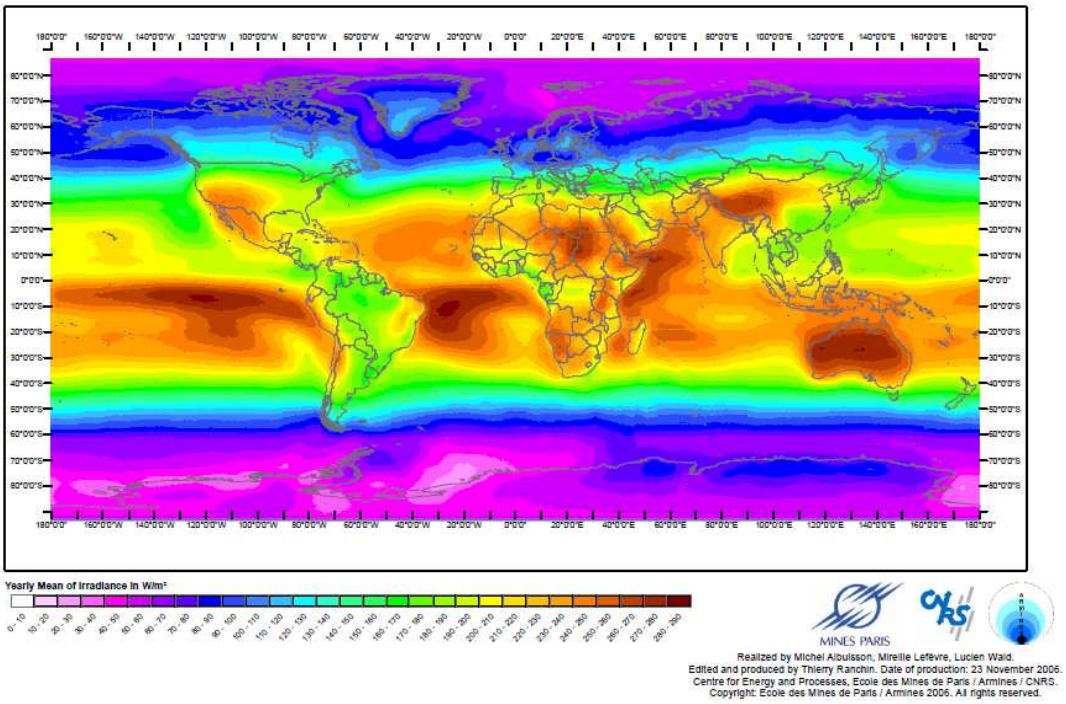
> "a mechanism to acquire demand-side resources (energy efficiency / load reduction) under which a utility purchases resources based on a pre-determined rate (e.g., R/kWh or R/kW). Purchase rates can be determined by the long-run marginal cost of supply or estimated subsidies necessary to attract commercial bids. ESCOs, equipment suppliers or other organizations that can deliver energy / demand savings at the agreed rate are eligible to submit projects and are paid once the projects have been implemented and savings certified by an authorized monitoring and verification organization." (Nersa 2010).

SOP benefits will not be available to individual homeowners, but only to registered energy services companies (ESCOs). The proposed payout in 2010 will be 54c per KWh saved per month. The energy saving achieved through installation of a SWH will initially be deemed to be 200KWh per month, thus delivering a SWH subsidy under the SOP of R108 per month (Nersa 2010). It is unlikely that a specific SWH installation would be able to qualify for both the SOP and Eskom subsidies (Ndlovu 2010).

1.2 History of solar water heating in South Africa and present position

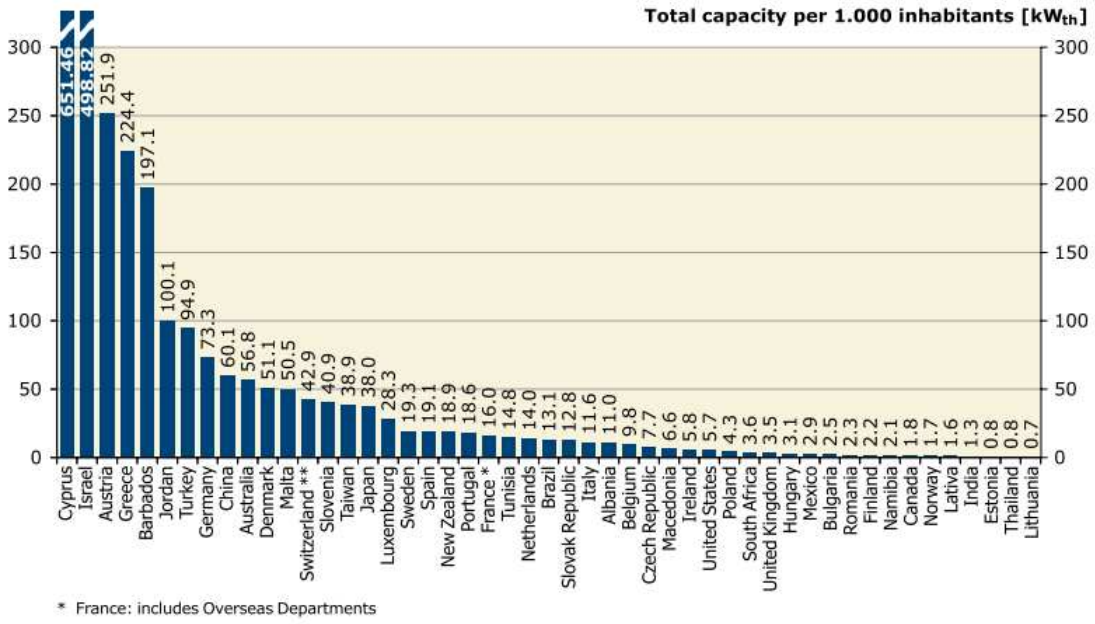
Despite South Africa's abundant sunlight (see Figure 2), there is a very low penetration of SWHs. Many European countries, with much lower average solar radiation, have a much higher SWH penetration (Figure 3). The rate at which new SWHs are being installed in South Africa is very low in comparison to countries that are leaders in the SWH sector (see Table 2).

Figure 2: Average solar radiation 1990 - 2004



Source: Soda 2010

Figure 3: Total capacity in GWth of SWHs per 1 000 inhabitants for 2007



Source: Weiss *et al* 2009

Table 2: Annual installation of SWHs in m^2 for 2007

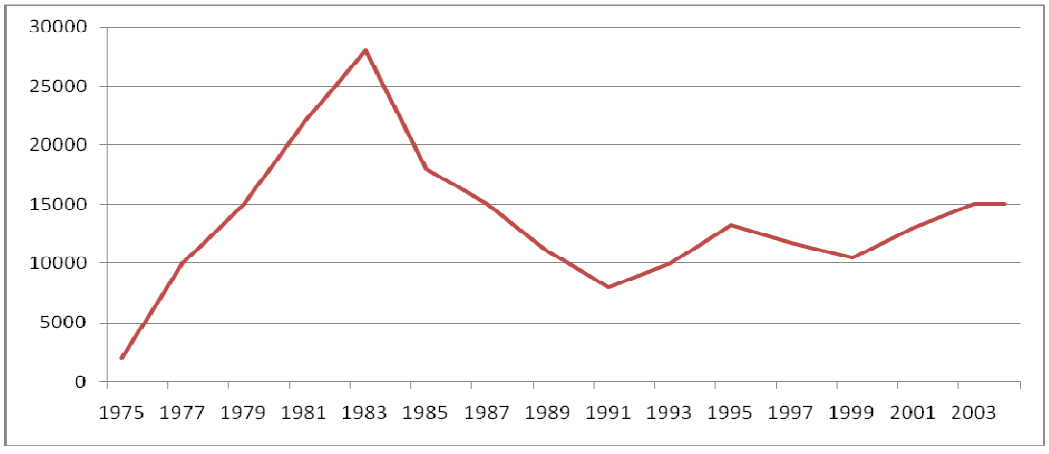
China	30 million m^2 per year
Germany	1.615 million m^2 per year
Turkey	1.12 million m^2 per year
South Africa	at most 100 000 m^2 per year

Source: Weiss *et al* 2009

There are currently a minimum of 4.2 million electric water heaters installed in South Africa in the domestic sector (DE 2009) but only an estimated 77 000 SWHs (Worthmann 2010), equating to a SWH penetration of less than 2%.

As can be seen in Figure 4, the SWH industry grew rapidly from 1975 to 1983. This was mostly due to marketing efforts by the CSIR (Holm 2005). Sales of SWHs slowed down after that initial growth spurt due to the reduction in government support and installations of some poor quality units which gave the industry a bad name. Installations of SWHs have started to pick up again since 2005 when the South African government resumed its promotion of SWHs, mainly through the Central Energy Fund (CEF). The growth in sales was especially significant in the first part of 2008 when the country experienced load shedding due to capacity constraints of the national utility company, Eskom. The doubling of the Eskom subsidy in January 2010 does not seem to have had a significant effect on sales (Hertzog 2010). It is difficult to source reliable statistics on current SWH sales in South Africa but annual sales are estimated at between 25 000 and 35 000 SWHs. This is very low compared to the more than 400 000 standard electric water heaters sold per year (Roux 2010; Schultz 2010).

Figure 4: Annual glazed SWH installations 1975 – 2003



Adapted from: Holm 2005

If the SWH industry had continued to grow at the same speed as it did in the late 1970s and early 1980s (3 000 units per year), the annual installation of SWHs would have been 109 000 per year in 2010. Even if the installation rate had remained constant, the penetration of SWHs in the domestic market would have been much higher than it is at present.

The uptake of SWHs in South Africa in general could be accelerated through legislation. There are various initiatives underway in this regard. The National Regulator for Compulsory Specifications (NRCS) has drafted a new section of the National Building Regulations (NBR XA) aimed at improving energy efficiency in new buildings and, possibly, in extensions to existing buildings. A notice by the Department of Trade and Industry (DTI) amending the National Building Regulations and Building Standards Act 2008 (Act No. 103 of 1977), published on 11 June 2010, introduces new requirements for new buildings to make them more energy-efficient than similar buildings built in the past. This regulation will ensure that all new buildings have:

> "at least 50% by volume of the annual average hot water heating requirement provided by means other than electrical resistance heating, including but not limited to solar heating, heat pumps, heat recovery from other systems or processes and renewable combustible fuel" (DTI 2010).

It is unlikely that this regulation will be enforced on existing buildings (Cohen 2010). Because the cost of a SWH is typically a small percentage of new building costs, it is anticipated that the extra cost of installing a SWH rather than a standard electrical unit could be absorbed by the developer. In sheer numbers however, SWHs installed in new buildings are unlikely to overtake the already installed standard electric water heater population of 4.2 million units. There are significant obstacles to regulating the replacement of existing standard electric water heaters because there is no requirement for scheduled building inspections once construction of a new building is completed. It could, however, be achieved through the introduction of a plumbing regulation to enforce energy-efficient water heaters in all cases. The plumbing regulation enforcing drip trays under water heaters, which was put into effect in 1981, is an example of a very effective regulation which is strictly adhered to by the plumbing industry (Roux 2010). Any initiative aimed at universal replacement of standard water heating units would need to take into account the initial financial outlay and seek to find ways to avoid overburdening the consumer.

Some municipalities are investigating the possibility of introducing energy-efficient water heating by-laws for new buildings. The City of Cape Town is most notable in this regard. Because the proposed new national building regulation is expected to be in place by mid 2011, municipalities have shifted their priorities to other programmes. Some municipalities, such as the City of Cape

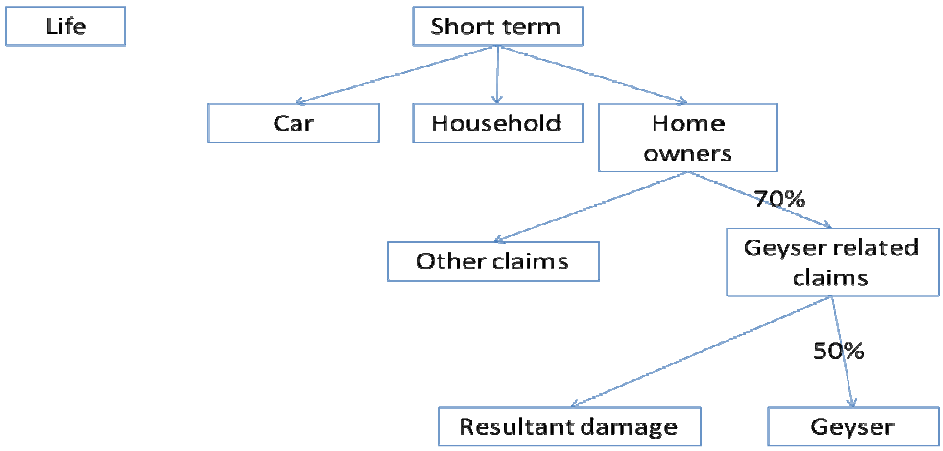
Town and the Nelson Mandela Bay Municipality (NMBM), are investigating the possibility of financing installation of SWHs via the municipal billing system (Roggen 2010, van der Merwe 2010). Although the NMBM are very far advanced in their investigation, no such programme has been implemented to date in South Africa.

SWH technology is the simplest, most potent and most cost-effective renewable energy solution available at the current time, and it can potentially also be rolled out in the shortest possible time. If water is heated by a SWH, significant amounts of electricity can be saved. This immense potential is not being utilised in South Africa at present. A change in the status quo requires collaboration between all relevant parties.

1.3 Role of the insurance industry in the supply of water heaters

The insurance sector in South Africa is established in two sections, namely life insurance and short-term insurance. The section that is involved in the water heating industry is short-term insurance. There are three basic types of short-term insurance: insurance of a motor vehicle, household (contents) insurance, and insurance of buildings. A water heater, as a fixed unit within a building, falls under the latter category of building, or homeowners, insurance.

Figure 5: Schematic of the insurance sector in South Africa

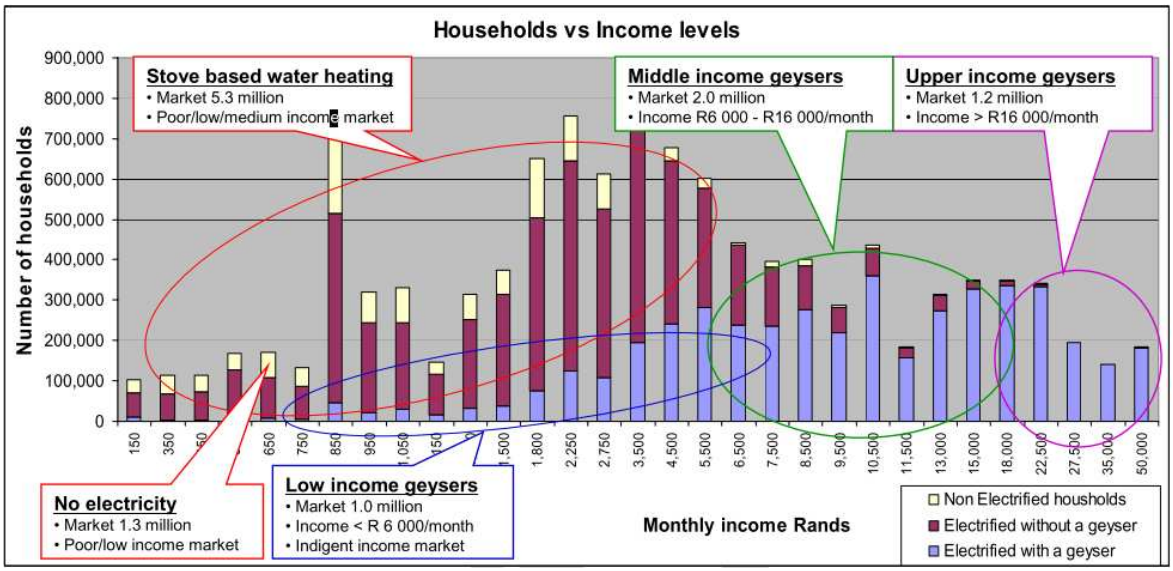


Because the water heater is deemed to be a permanent fixture in the home, most water heaters in middle- and high-income homes in South Africa are insured by default. Most middle- and high-income homeowners in South Africa have comprehensive insurance of their homes. Building insurance is compulsory if the homeowner has a home loan or mortgage bond registered against

the property. When a home loan is registered, by default the insurance policy is awarded by the financial institution where the bond is held. Although this is not mandatory, the reality is that the majority of homeowners policies in South Africa are held by the insurance divisions of the major banks. Homeowners' insurance typically carries a lower monthly premium than car or household insurance. The premium is calculated on the value of the house, adjusted by a factor for the area in which the house is situated and for the detail of what is covered in the insurance contract. Even though water heater related claims make up about 70% of all claims on homeowners' insurance policies (de Ridder 2010a, Addison 2010), information on the number and type of water heater installed is seldom required when the policy is taken out, and typically does not influence the monthly premium paid by the homeowner.

There are about eleven million households in South Africa. About 3.2 million of these fall into the middle- and high-income groups. These households would typically have household insurance on their homes and would have the financial means to make up the capital difference to change to a SWH when their water heater fails (see Figure 6) (DE 2009). Some of these households might even have two or more water heaters in their homes. All the water heaters in a house will be insured on the homeowners policy, however only one water heater per household will qualify for the Eskom subsidy. With the new Mzanzi insurance schemes aimed at assisting lower income households to access homeowners insurance, another one million or more water heaters could potentially be added to the 3.2 million households nationally that have insured water heaters.

Figure 6: South African household income levels



Source: DE 2009

About 450 000 water heaters are installed annually in South Africa. Of these, 110 000 are installed in new buildings, about 3 000 are replacements by the manufacturer of water heaters that failed while still under guarantee, and about 285 000 are replacements of water heaters that have endured beyond the manufacturer's guarantee period (Schultz 2010). Of the latter 285 000 replacement water heaters, about 200 000 are procured and installed via the insurance industry (Aquisto 2010a). This figure is double the number of water heaters installed in new buildings and close to 50% of all installations; it clearly underscores the potential role which the insurance industry can play in the roll out of SWHs in South Africa.

Until the early 1980s, an assessor used to come to the insurance policyholder's house in the event of a failed water heater, to assess the damage. The policyholder would have no hot water until the damage had been assessed and the new water heater installed. The process was modified over time and nowadays the administration of water heater replacements has often handled by Incident Managers, who claim to bring down the amount of claims by up to 25% with their systems (Aquisto 2010b).

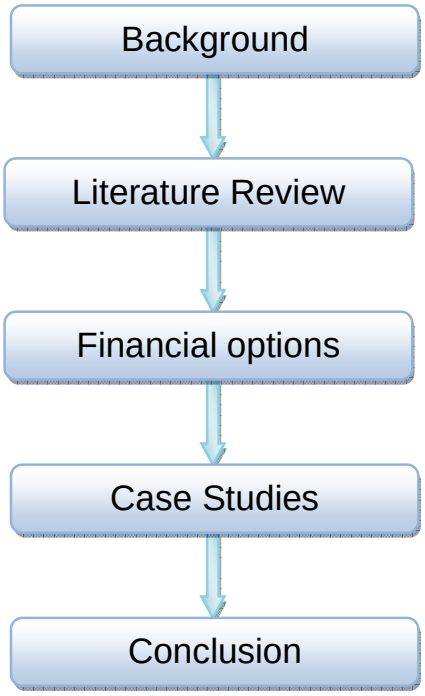
There are several water heater manufacturers in South Africa but one manufacturer, Kwikot, has a monopolistic control over the replacement market. While water heater manufacturers like Franke, W.E. and GAP are well established suppliers for new installations, Kwikot dominates the replacement market through the insurance industry (de Ridder 2010a).

The short-term insurance industry in South Africa has been identified in some government documents, most notably emanating from the Department of Public Enterprises (Roux 2009) and Department of Energy (DE 2009), as a key point of change for the SWH industry. The insurance sector is also mentioned in the *Strategy for a developmental green economy for Gauteng* (Spencer *et al* 2010).

SWHs have been the subject of some high-level discussions between policymakers and key players from the insurance industry, and some programmes were developed in partnership with government departments where a policyholder can choose to have a SWH installed in place of a failed water heater. In this case the price difference between a standard electrical water heater and a SWH is carried by the policy holder. The most notable is the national SWH programme introduced countrywide by Santam in February 2010 (Creamer 2010a). Absa Insurance is currently running a SWH pilot programme in the Western Cape (De Ridder 2010a).

1.4 Research design and methodology

1.4.1 Thesis outline



1.4.2 Research questions and methodology

Close to 50% of all standard water heaters installed in South Africa are procured and installed via the insurance industry due to the failure of units that have endured beyond the manufacturer's guarantee period (Schultz 2010, Roux 2010). This presents an opportunity for interventions that encourage policyholders to change to SWHs at this point. These interventions have the potential to dramatically speed up the roll out of SWHs in South Africa.

In this research, the role of the insurance industry in the roll out of SWHs in South Africa is investigated. The purpose of the research is to advance our understanding of the challenges and obstacles that inhibit the use of solar water heating and prevent it becoming a nationwide commercially viable practice.

In the preliminary stages, the researcher focused on financial mechanisms that are designed to render the change to SWHs affordable at the point of water heater failure by utilising the insurance payout as a discount. The researcher found that the pricing of SWHs (even excluding the Eskom subsidy and the discount for insurance payout) is low in comparison to the cost of electricity used to

heat water with an electric element. As a result, the focus or the research changed and an attempt was made to find out why so few SWHs are being installed in South Africa. In addition, the researcher attempted to establish why so few insurance companies have programmes to support the installation of SWHs (only one at the beginning of 2010 and two by June 2010).

The research questions can thus be expressed as:

1. What obstacles and challenges prevent SWHs from becoming the water heater of choice in South Africa?
2. How can the insurance industry assist in overcoming these obstacles and challenges?
3. What role can the insurance industry play in driving the mainstreaming of solar water heating systems and technologies?
4. Which established theoretical frameworks can be enlisted to develop an understanding of this socio-technical system and support its transition?

The methodology used in this research can be described as qualitative research coupled with documentary analysis and, more particularly, case studies and a literature review. A case study is defined as empirical and ethnographic research and is described by Mouton (2001) as studies being qualitative in nature with the aim to provide in-depth descriptions of a small number of cases. He further describes the methods and sources of data as being participant observation, semi-structured interviewing and use of documentary sources and other existing data. The strength of this type of research is described as having high construct validity, giving in-depth insights and establishing a rapport with the research subjects (Mouton 2001).

This method was chosen because sustainable development requires that the research be understood from a complexity and systems perspective (Gallopin 2003, Clayton & Radcliff 1996). Qualitative interviews were conducted with key industry players. Interviews were done in person or telephonically and conducted in a qualitative, semi-structured way as described by Spradley (1979) as seeming almost like friendly conversations. In this way the researcher was able "...to explore complex issues in the subject area by examining the concrete experience of people in that area and the meaning their experience had for them" (Seidman, 1998). Structured questionnaires were not used but an outline was drawn up of topics to be covered and often e-mailed to participants before the interview. In this way, understanding was gained of the opportunities and challenges presented in the interaction of the solar water industry and the insurance companies.

The interviews with the insurance and banking sector key players were often a two-way exchange of information. Participants were more willing to divulge information and their opinions on issues when there was a two-way communication. Participants from the insurance sector specifically would only set aside a short time for the interview but, after realising how much can be gained by them, would extend their time or schedule a follow-up meeting. In these cases, the research design could be described as participatory research as the participants are involved as an integral part of the design (Mouton 2001). This research might even be described as participatory action research (PAR), even though PAR is more often used to describe research done in community and development studies (Mouton 2001). Gardner (2004) describes PAR as, "removing the distance between the objective observer and subjective subject and includes the community being studied as an active participant in the research, with an end goal of empowering the community to create change."

Interviews were recorded, unless permission for this was not granted. Some key interviews were transcribed. Electronic records of all interviews and transcripts are held at the offices of Prof. Ben Sebitosi, at the Centre for Renewable Studies, University of Stellenbosch. Copies of interviews with Santam Insurance and Absa Insurance will only be made available with written permission from them. A research journal was kept where notes of interviews were recorded and reflections on the research written down. See Appendix 1 for the details of all interviews conducted.

After initial contact was established with participants, the relationship was maintained with regular telephone calls and e-mail messages for clarification of ideas by both the researcher and the participants. In some cases, however, no progress was made even after e-mail correspondence and meeting. This pinpoints the important role rapport plays in research of this kind. Electronic copies of all e-mail correspondence relating to this research are available from Prof. Ben Sebitosi at the Centre for Renewable Studies, University of Stellenbosch. See Appendix 2 for a list of e-mail correspondence.

The word used to refer to a person being interviewed says a lot about the researcher's view of the relationship. In this study, the word "participant" is used as it captures both the sense of active involvement and equality (Seidman 1998). The term "informant" may also have been useful because the researcher was informed by the persons interviewed. The term "interviewee" or "respondent" is not used as it places the person being interviewed in a passive role.

Contact with industry players was established via various means. Interviews were at first set up in collaboration with a fellow student working on the same topic. Many contacts were made through participation in workshops and conferences. Contact with Hollard Insurance was established early on in the research through contacts of Mark Swilling from the Sustainability Institute.

All the main insurance companies and banks, SWH companies and industry (SWH as well as insurance) organisations were contacted via their websites. This method proved to be of varying effectiveness, sometimes resulting in interviews with employees who do not have real knowledge or understanding and no authority to divulge key information. The South African Insurance Association (SAIA), the City of Cape Town, Kwikot and Eskom proved to be exceptions and strong relationships were formed. The researcher was invited to a Sustainability of Insurance forum organised by SAIA on 7 May 2010 in Johannesburg. The networking done with industry players at this meeting proved to be vital to this research.

Contact was established with the Banking Association via contacts of Mark Swilling through the Sustainability Institute. Through this initial introduction to the Banking Association, contact was established with Absa Insurance.

Non-disclosure agreements were signed with Santam Insurance and Absa insurance to gain access to sensitive corporate information and statistics. The sections of the draft thesis pertaining to the communications covered by these agreements were e-mailed to the relevant persons and corrections were made before finalising the thesis.

An attempt was made to access statistics on SWH and water heater sales in South Africa. No accurate up-to-date statistics were found for SWH sales (Holm 2010, Worthman 2010). Statistics for water heater sales were received from Kwikot (who have 70% of the standard water heater market in South Africa) in reply to a website query (Schultz 2010). The number of SWHs installed via the insurance industry at point of water heater failure is so low as to be insignificant (de Ridder 2010b, Genis 2010b, Aquisto 2010b).

In addition to the interviews and as a background to the study, a literature review was conducted. Mouton (2001) describes the literature review as the cornerstone of any research project. A literature review is an ongoing process that includes the selection of literature relevant to the research, but may develop as new perspectives arise (Bless & Higson-Smith, 2000).

Search topics were selected to provide the theoretical framework to contextualise the research. The database at the JS Gericke Library at Stellenbosch University was used for this. The searches were made as wide as possible and included books, journal articles, reports, conference papers and completed theses. As this research is contemporary in nature, searches in the press as well as specific industry publications were done as well.

Search words included; Sustainable development, renewable energy, climate change, carbon emissions, solar water heating, solar thermal, insurance, corporate social responsibility, innovation,

disruptive innovation, sosio-technical systems, sosio-technical transition, complexity, systems thinking and sustainability orientated innovation systems.

The literature review included readings on renewable energy policies for the promotion of SWHs and SWH statistics, readings on climate change, risk and the insurance industry, corporate social responsibility and marketing theory. In addition, the review included literature which identifies socio-technical systems, providing a conceptualisation of the role of socio-technical system transitions in the context a new era of more sustainable living and renewable energy. The aim of this was to further an understanding of the concept of technological “lock-in”.

Chapter Two: Literature Review

2.1 Introduction

This literature review establishes a theoretical background for this study which might be useful to the insurance industry as well as the SWH industry in South Africa.

Firstly, literature on policies for the promotion of SWHs are discussed. Thereafter, climate change, carbon financing, risk and insurance set the context in which SWH technology is situated. Society is nowadays placing more emphasis on *how* businesses generate profit, not just *how much*. Renewable energy and energy efficiency forms part of this new vision for companies. For this reason, corporate social responsibility is included. Lastly and most importantly, socio-technical system theories are discussed. Perez points out in the foreword in Grin *et al* (2010:13) that, while engineering and the hard sciences are tasked with the development of alternative energies and other technical means of addressing environmental challenges, the social sciences have to confront the task of understanding transitions and how to influence them. Most of the theory on this subject comes from the Dutch Knowledge Network on Systems Innovations and Transitions (KSI) Project, which was set up in 2004 and is affiliated to the University of Amsterdam, the Erasmus University Rotterdam and the Technical University Eindhoven. The KSI has developed many practical projects and research programmes focusing on the process of transitions in society (KSI 2011).

2.2 Policies for the promotion of SWHs

Renewable energy and energy-efficient policies from governments are developed for many different reasons. Some of these are: energy security, local pollution reduction, reduction of carbon emissions, equity and greater financial efficiency (Sustainable Energy Africa 2009).

According to Holm (2005), the drivers for the use of SWHs are job creation, environmental concerns, energy security, peak demand reduction, and stimulation of the national economy. He further states that merely having good solar conditions does not necessarily lead to a higher uptake of SWH in a country. South Africa is a good example of this. This country has enough solar

radiation for a good SWH penetration into the market. This is, however, not used to its anywhere near its full potential. This section reviews literature on international SWH policies and penetration results. The researcher found no international examples of programmes where the replacement of water heaters by SWHs via the insurance industry are encouraged or enforced. Neither were international examples found of any insurance-driven SWH programmes.

Government policies concerning SWHs can be divided into two categories: SWH obligations, and SWH subsidies. A building regulation aimed at making SWH installations mandatory is an example of an obligation. SWH subsidies include capital cost reduction subsidies and subsidies paid out against energy savings or emissions reductions.

Government policies in South Africa were described in Chapter 1.1. The country has had a SWH subsidy in place since 2008 but the uptake of these subsidies has been very low. Investigations into a new Standard Offer Programme (SOP) are currently underway.

South Africa has no obligation policy for SWH installation in place at present. However, a national building regulation enforcing SWH installation in all new buildings is expected to be in place by March 2011 (DTI 2010, van der Merwe 2010a). This regulation was drafted by the National Regulator for Compulsory Specification (NRCS) and will be applicable to all new buildings. It may also be applicable to additions to existing buildings but it is not anticipated that this regulation will extend to the replacement of existing water heaters (Cohen 2010). Because 35% of water heater installations in South Africa are installed in new buildings, this regulation could have a positive impact on the growth of sales and installations of SWH in this country. The market for replacement water heaters via the insurance industry is dominated by one manufacturer; almost 70% of all replacement water heaters installed via the insurance industry are Kwikot water heaters (de Ridder 2010a). Kwikot holds a 70% share in the overall water heater market (Schultz 2010). A building regulation enforcing SWH installation would thus have a severe impact on the smaller electrical water heater manufacturers within South Africa, whilst it will have a lesser impact on Kwikot. Kwikot manufacture a line of SWHs, under the name Kwiksol. In the twelve months to July 2010, Kwikot sold 9 252 SWHs (van Zanten 2010).

According to the draft of the *South African national solar water heating framework and implementation plan*, new regulations requiring homeowners to achieve a certain level of energy efficiency might be implemented in the future (DE 2009).

For renewable energy policies to have the desired results, they must be relatively simple, predictable and stable in the long-term. Any renewable energy or energy-efficiency policy has to be trusted. If a consumer does not trust that a subsidy will be paid out, or if the future of the policy is in

doubt, it will adversely affect the uptake. An increase in a subsidy amount may have unintended consequences. A consumer might hold back his purchase if he is anticipating a bigger saving in the future. If a subsidy programme has a very low uptake, as is the case with the Eskom SWH subsidy programme in South Africa, one would expect that a doubling of the subsidy amount will result in more people applying for the subsidy. This is not necessarily correlated with more sales; it merely means that there are more people taking the trouble to engage with the bureaucratic administrative process because it is more worth their while. If there is a possibility that a subsidy will be reduced or be replaced in the near future, many customers will not install a SWH as they do not trust that they will receive the subsidy. If the organisation administering the subsidy is not trusted, or if the bureaucratic process to claim a subsidy is difficult, not understood, or takes a long time, the policy will also not have the desired results. The market needs certainty to grow and develop.

Israel has had a SWH building regulation in place since 1980, and 95% of households in Israel now use SWHs (Pearl 2009). Israel has the second highest per capita installations of SWH in the world (Holm 2009), at the rate of 498.82 SWHs installed per 1 000 inhabitants (Austrian Development Cooperation 2010). On the other hand, Cyprus has no enforced obligation for the installation of SWHs but the installation rate is 651.46 SWHs per 1 000 inhabitants, which is the highest per capita SWH penetration in the world (Austrian Development Cooperation 2010). Cyprus has a high electricity price and a very good SWH testing facility (Holm 2010). Malta is comparable to Cyprus in weather patterns, size and situation (both are islands situated in the Mediterranean Sea) and both have high electricity prices but, in stark contrast to Cyprus, Malta has a very low uptake of SWH. Malta has no SWH testing facility and virtually no SWH industry. The first SWHs installed in Cyprus were imported from Israel in 1954. In 1974 there was political upheaval in Turkey and many refugees settled in Cyprus. The government of Cyprus built homes for the refugees and all of these were fitted with SWHs. In this way, the government established what is now a strong SWH industry.

China installs the highest number of SWHs worldwide and also has the fastest growing market for SWHs (Weiss *et al* 2009). China has no SWH subsidies or other financial instruments in place to promote installation of SWHs. There are, however building regulations in place in some cities to promote the integration of SWHs into certain new buildings (IEA 2010).

Austria has the third highest per capita penetration of SWH in the world (Weiss *et al* 2009). The country has capital subsidies as well as other fiscal measures to promote the use of SWHs (CTRAN Consulting 2010).

From the above examples, it is clear that there is not only one route a country can take on the path towards having a high penetration of SWHs. Israel has had great success with mandatory regulations enforcing the installation of SWH. Cyprus has done even better without any enforcing regulation but by having a very good testing facility which raises the trust that consumers have in the technology.

The South African government has set a target to roll out one million SWHs by 2014. This objective is supported at the highest level and even Jacob Zuma, the president of South Africa, has put his name behind it. The detail of the implementation strategy is not very clear but it appears that there is a plan to install 200 000 SWHs before the end of 2011 (van der Merwe 2010b). The *White Paper on Renewable Energy* (DME 2003) targets 10 000 GWh per year of renewable energy in South Africa by 2014. If one SWH saves 2 400 KWh electricity per year, one million SWHs will be able to make up 24% of this target (2 400 GWh). 4.2 million SWHs (the total number of water heaters installed in South Africa at present (DE 2009)) would make up the targeted 10 000 GWh without the need for any other renewable energy technology.

The South African government's objective is that, by the year 2020, 50% of residential water heating needs in South Africa will be supplied by solar water heaters, plus there will be widespread use of solar water heating and other new heating technologies in the commercial and industrial sectors (DE 2009).

The South African Cabinet started a process in 2006 to examine the potential for mitigation of GHG emissions in the country. Long term mitigation scenarios (LTMS) were produced to give Cabinet a scientific analysis from which to draw up their climate policy. SWHs form part of the mitigation technologies identified in this document (Scenario Building Team 2007).

2.3 Climate change, carbon financing, risk and insurance

Climate change could impact on the wealth of countries and companies by various means, such as the availability of resources, the price of energy and their potential to show profits. However, changing the way we use energy could stimulate economic development and employment.

It is the responsibility of the financial services sector to prepare itself for the effects that climate change may have on its business but it can also help with the mitigation of economic risks and lead the shift to a low-carbon economy by providing appropriate products and services (Dlugplecki & Lafelt 2005).

The financial services sector can change its processes, policies, products and services to not only safeguard its own viability but also meet the challenges its clients will face. In order to do this, financial services companies should include climate change risks in their governance procedures.

The insurance industry forms part of the financial services industry and has a specific interest in climate change, due to their role as risk managers. It is predicted that the distribution and intensity of extreme weather conditions will increase due to climate change, with resultant increases in insurance claims. It is estimated that such weather related claims will increase by between 2 and 4 percent a year. If this should happen, claims of this type will at least double by 2050. Most of the predicted damage is direct damage due to weather related incidents, but there could in addition be claims for loss of sales, heat stress, travel delays and pollution from floods (Dlugplecki *et al* 2005). Because insurance premiums are calculated on historical data, it is estimated underpricing of premiums could arise in the context of climate change.

In the first report of the Insurance Working Group of the United Nations Environment Programme Finance Initiative (UNEP FI IWG), "Insuring for Sustainability – Why and how the leaders are doing it", some sustainability issues were identified for attention of the insurance industry. One of the issues is climate change and the impact of increased extreme weather conditions, as described above. Another issue is recycling and what to do with items written off in insurance claims (UNEP FI 2007). The influence that the insurance industry has on the choices of replacements in insurance claims is not discussed in the document. The IWG is currently developing Principles for Sustainable Insurance, which will be complementary to the UN Principles for Responsible Investment. This initiative seeks to create a network of insurers who address sustainability issues by pooling resources and learning from each other.

The concept of international trade in GHG reduction credits has existed since the mid-1980s. The United Nations Framework Convention on Climate Change (UNFCCC) formally recognised this possibility in 1992 and the Kyoto Protocol in 1997 laid the groundwork for three market-based mechanisms. These market mechanisms are: International Emissions Trading, Joint Implementation, and the Clean Development Mechanism (CDM). Many voluntary and regulatory programmes to control GHG emissions allow trading in emissions as a means of providing market participants a choice in meeting their commitments. The CDM is the most widely used carbon market mechanism in developing countries. The CDM is designed to help industrialised countries lower the cost of meeting their emissions targets by taking advantage of less expensive opportunities in developing countries through activities that contribute to sustainable development goals. Of the three mechanisms established by the Kyoto Protocol, only the CDM provides a

means for registered projects to accrue certified emission reductions (CERs) prior to the first commitment period (Milton & Kaufman 2005).

The CDM was established by Article 12 of the Kyoto Protocol. This mechanism was intended to provide transfer of clean technologies to developing countries as well as stimulate direct foreign investment to these countries, to improve the local environment and to receive some income from the sale of the CERs. This mechanism will possibly fall away in 2012 when the Kyoto Protocol comes to an end. It is not clear as yet what kind of carbon reduction financing mechanism will be put in its place (Boal *et al* 2005). The uptake of CDM projects by private financial institutions has been low according to Boal *et al* (2005). The reasons given for this are the specific risk structure of the CDM projects, various institutional barriers and the complexity when implementing a CDM project.

According to Milton (2004), carbon finance can harness market forces for the greater good and is thus an important sustainable development vehicle.

A SWH project is an excellent way for a financial institution, be it from the banking or the insurance sector, to become involved in the move towards a low carbon economy to help in the mitigation of climate change.

SWHs are particularly promising as a renewable energy application according to Milton *et al* (2005). It is one of the simplest and least expensive ways to harness renewable energy and can be comparatively cost-effective for reducing GHG emissions. With financial and other types of support via carbon trading mechanisms, SWH technology could be a valuable component of climate change mitigation efforts. There is however only one CDM project registered in the world where installations of SWH make up a part of the project; this is the low-cost housing development in Kuyasa in Khayelitsha, Cape Town, South Africa (Abel 2010). This project involved the installation of low energy lighting (CFLs), insulation in the form of ceilings, and the installation of SWHs.

South Africa is living on the edge where climate change is concerned (Taylor 2009). Most of South Africa is desert or semi-desert and this country has a very long coastline. The Cape Floristic Kingdom in the Western Cape, with its beautiful fynbos, has one of the most abundant number of fauna and flora per square metre in the world and is one of the regions that are projected to be most sensitive to climate change (Smith *et al* 2001). Not only could many plants and animals be lost for future generations, but this region is also an economic hub for fruit, wine, grain and animal farming, the economic future of which is uncertain. Replacing standard electric water heaters with SWHs will lower the electricity consumption of households. As most of South Africa's electricity in

generated in coal-fired power stations, the lowering of electricity consumption will lower the country's carbon emissions and thus help in mitigating climate change.

Abel 2009 describes a scenario for a SWH-based CDM programme in South Africa, which would most likely be registered as a programmatic CDM (pCDM). This type of CDM is used when many small units (such as SWHs) are dispersed geographically and are not installed at one time. It could be possible to register a pCDM as a SWH industry initiative and have all SWH installations benefit from it. Participation could be via the insurance company but could, in addition, be through any other programme (such as a SWH financing scheme) with the carbon revenue going to the institution paying for the installation of the SWH. The average estimated selling price per ton carbon dioxide equivalent (tCO_2e) according to Abel (2009) was R100 in 2009. The estimated carbon dioxide equivalent (CO_2e) is taken as 2 tons per year (the equivalent carbon emissions for a SWH saving 200KWh of electricity per month) (Eskom 2000). This would generate a carbon income per SWH of R200 per year, or R2 000 over ten years. In a telephonic interview in September 2010, Duncan Abel from Unlimited Energy said that the price per ton of carbon to be realised for the foreseeable future would be about 13.50 to 14.00 Euros. However, he estimated that, if the pCDM is pre-sold, only about 6 Euros per ton could be realised for post 2012 CDMs because the future of the carbon market is unclear. This would come to about R100 per SWH per year (Abel 2010). The pCDM could run for as long as the contract stipulates or for the life of the SWH.

According to Baier *et al* (2009), organisations are starting to track carbon emissions as rigorously as they track revenue and expenses due to demands by investors, customers, employees, communities and governments.

One of the South African banks, Nedbank, has recently announced the achievement of their carbon neutrality as a business (van der Merwe 2010c). This step cost the bank around R14 million. R2 million was spent on measuring of the carbon emissions and around R12 million was spent on buying carbon credits for 213 000 ton of CO_2e to offset the carbon emissions that could not be cut. They thus spent about R56 per ton of carbon equivalent. The carbon credits were purchased from the Rukinga project in Kenya. This is Africa's first large-scale initiative to reduce emissions from deforestation and degradation of forests. It appears that Nedbank unsuccessfully attempted to purchase carbon credits from a South African project to offset their 2010 emissions.

Nedbank is saving approximately R28 million per year through green initiatives leading up to its claimed carbon neutrality (van der Merwe 2010c), which suggests that green initiatives do not need to cost a company money.

2.4 Corporate social responsibility

The idea that a business or corporation should 'give back' to society is not new, yet the meaning and practice of corporate social responsibility (CSR) is constantly evolving as the relationship between business and society changes. Some businesses used company capital to provide housing, schools and other social facilities for their workers as early as 1800 (Blowfield & Murray 2008). These strategies were recognised as not only philanthropic, but also as a means to increase profit and were mostly attributed to the individual who ran the company. Around 1950 the understanding of CSR moved away from the individual business personality to the behaviour of the company as a whole. Over the last twenty years, the notion of CSR has evolved from voluntary charity to stakeholder engagement and collaboration. See Table 3 for a more detailed timeline of the development of CSR.

Table 3: Timeline of corporate social responsibility

	1930	1940	1950	1960	1970	1980	1990	2000
First corporate responsibility texts								
New Deal and welfare state								
Nationalisation (Europe), state enterprise (former colonies, Communist Block); post-war consensus (USA)								
Return of business and society debate								
Shift from responsibility of leaders to responsibility of companies								
Debate about nature of responsibilities								
Introduction of stakeholder theory								
Corporate responsibility as mangement practice (e.g. corporate social responsiveness)								
Environmental management								
Corporate social performance								
Stakeholder partnerships								
Business and poverty								
Sustainability								

Source: Blowfield *et al* 2008

Because the purpose and use of CSR has changed through the years, it is not an easy term to define. The term is constantly changing as society itself changes. CSR was seen by Carrol (1991) as a hierarchical pyramid of responsibilities made up of four tiers, namely economic, legal, ethical

and philanthropic. This model, however does not clearly address the problems when responsibilities at different levels of the hierarchy are in conflict. The tension between issues such as job creation and environmental protection or carbon footprint is offered as an example.

Blowfield and Murray (2008) define CSR as, “an umbrella term that captures the various ways in which business’ relationship with society is being defined, managed, and acted upon”.

CSR typically addresses issues such as environmental management, sustainability, animal rights, human rights, market relations, corruption, corporate governance, legal compliance, philanthropy and community investment.

It is now recognised that business practice, and the consumer culture that it created, is responsible for much of the environmental degradation and waste in our world today (Jorgenson 2003, Rothman 1998). As a result, business is perceived as being responsible for providing green solutions (Blowfield *et al* 2008). The range of environmental issues that companies are expected to tackle is broad and often require legislation.

Economic growth and development in South Africa is still coupled to resource use and leads, not only to resource depletion but also, to pollution, destruction of ecosystems, excessive waste and high carbon emissions. We not only face the challenge of eradicating poverty and retaining our growth rate to be able to distribute the wealth more fairly but, in addition, we need to find ways in which to decouple growth rates from the ever increasing levels of natural resource use and waste. This is more commonly referred to as dematerialisation (Swilling 2007). Grin *et al* (2010) also see the current economic crisis as a symptom of a deeper lying systems crisis, which are seen as being rooted in the imbalance between unsustainable consumption and production patterns.

For the multiple environmental impacts of businesses to be diminished, business needs to be held accountable for its practices.

CSR is sometimes seen as being anti-business (Blowfield *et al* 2008) but this does not need to be the case. A company without a strong CSR policy is now considered unsustainable. By providing a strong business case for CSR, it has moved from a philanthropic exercise to good business practice.

Table 4 below illustrates the correlation between critical business measures and dimensions of CSR. There might not be a strong correlation between CSR and profitability, but there is a strong case for CSR in terms of creating competitive strategic advantage and longer-term preservation of value. The three key areas of the business case for CSR according to this table are eco-efficiency,

protecting corporate reputation and risk management. According to this model, adopting the triple bottom line has some positive impact on all business measures except for innovation.

Table 4: Areas of correlation between corporate social responsibility and business performance

		Dimensions of Corporate Responsibility									
		Ethics: values, principles	Accountability and transparency	Adoption of triple bottom line	Eco-efficiency	Environmental products	Social development	Human rights	Working conditions	Business stakeholders	Non-business stakeholders
Business measures	Shareholder value										
	Revenue										
	Operational efficiency										
	Access to capital										
	Customer attraction										
	Brand value and reputation										
	Human capital										
	Risk management										
	Innovation										
	Licence to operate										

Key:

	Strong positive impact of corporate responsibility on business performance
	Some positive impact of corporate responsibility on business performance
	Neutral or negative impact of corporate responsibility on business performance

Source: Blowfield *et al* 2008

To transform the culture, structures and processes of a company takes time and it could take on many different forms depending on the context and size of the business. It could be a defensive strategy, which is merely about protecting risk and reputation, or an active strategy which addresses the problems in the society within which it operates. A CSR strategy is an evolutionary journey rather than an overnight turnaround. In Table 5 below this evolutionary journey of transformation can be seen as operating across multiple dimensions.

Table 5: Stages of corporate social responsibility

		Stages				
		Stage 1 Elementary	**Stage 2 Engaged**	**Stage 3 Innovative**	**Stage 4 Integrated**	**Stage 5 Transforming**
Dimensions	**Citizenship concept**	Jobs; profits; taxes	Philanthropy; environmental protection	Stakeholder management	Sustainability / triple bottom line	Change the game
	Strategic intent	Legal compliance	Maintain licence to operate	Make business case	Integration of value and values	Create new markets / social change
	Leadership	Minimal	Supportive	On top of issues	Ahead of the curve	Visionary
	Structure	Marginal	Functional ownership	Cross-functional coordination	Organisational alignment	Integrated into mainstream
	Issues management	Defensive	Reactive	Responsive	Proactive	Defines the issues
	Stakeholder relationship	Unilateral	Interactive	Mutual influence	Alliances and partnerships	Multi-organisational
	Transparency	Enough to protect flanks	Public relations	Public reporting	Assurance	Full disclosure

Source: Blowfield *et al* 2008

Because people do not often respond positively to change, a new CSR strategy in a business needs strong management and leadership capability. Management may need to initiate and manage a change in company culture and mindset and take responsibility for the behaviour of stakeholders. Good practice in achieving CSR goals could involve internal and external

consultation to decide purpose, engaging with stakeholders as part of the management process, and communication on progress in CSR.

When a company CSR is driven from the top of the organisation through visionary leadership and capable management, this process might be relatively painless and positive for all stakeholders. The drive toward CSR, however might come from middle management in a corporation, and the company might need to draw on outside knowledge to boost their managerial capacity.

An important part of managing CSR is finding a way to create responsibility to carry out the strategy. Tools are needed that can provide benchmarks and best practice principles, so that companies can aspire to, comply with or reach beyond a set of agreed upon CSR codes. There are many international and local standards that help companies address sustainable issues and guide the process of CSR by defining non-financial performance in a number of industries.

It is important to be critical of why and how standards have been created; "to say that a company has adopted a standard says little, in itself, about the performance, policies, or strategies of the company" (Blowfield *et al* 2008). Standards should come from a process of stakeholder engagement, and regional and national differences in standards might occur. Standards for CSR should always be critically evaluated, as there is a risk that adhering to standards and principles simply fosters a compliance mindset, which runs counter to the notion of sustainable business (Fremantle 2007). Some CSR standards are: the Millennium Development Goals (MDG) (UNMDG 2010), Global Compact (UNGC 2010), Carbon Disclosure project (CDP) (NBI 2009), Principles for responsible investment (UNPRI 2010), ISO 14000 series (ISO 2010), Global Reporting Initiative (GRI) (GRI 2010) , the Equator Principles (EP 2010) and the King report (SAICA 2010).

The vision of the GRI is for disclosure on economic, environmental and social performance to become as comparable and an everyday occurrence as financial reporting and as important to an organisation's success. The GRI aims to create conditions for the transparent and reliable exchange of sustainability information through the continuous improvement and development of the GRI Sustainability Reporting Framework (GRI 2010).

The National Business Initiative (NBI) runs the Carbon Disclosure Project (CDP) in South Africa. The top 100 businesses listed on the Johannesburg Stock Exchange (JSE) are asked annually to take part in this project. The top 16 companies are then listed in order of the quality of their disclosure. These companies are merely measured on their disclosure and not on the emissions itself. Four financial companies made it into the top 16 in 2009, Nedbank Group, Santam, Old Mutual and Sanlam (see Table 6) (NBI 2009).

Table 6: CDP leadership index JSE100: 2009

Rank	Company	Sector	Score
1	Nedbank Group	Financial	90
2	The Bidvest Group	Industrial	83
3	Woolworths Holdings'	Consumer	83
4	BHP Biliton	Materials	82
5	Gold Fields	Materials	79
6	Sappi	Materials	79
7	AngloGold Ashanti	Materials	75
8	Santam	Financial	75
9	Dimension Data Holdings	IT & Telecomms	74
10	Old Mutual	Financial	74
11	Sanlam	Financial	74
12	Anglo Platinum	Materials	73
13	Exxaro Resources	Materials	73
14	Northam Platinum	Materials	72
15	Netcare	Health Care	72
16	Sasol	Energy	71

Source: NBI 2009

In 2009, a pilot project was run where the companies were also measured on their emissions. These results were then published in alphabetic order according to sector. Three financial companies made it into the top 16 companies, namely Nedbank Group, Old Mutual and Santam (see Table 7) (NBI 2009).

Table 7: Top 16 companies in terms of CDP pilot performance score (by sector and alphabetically)

Company	Sector
Massmart holdings	Consumers
Pick n Pay Holdings	Consumers
SABMiller	Consumers
Woolworths Holdings	Consumers
Sasol	Energy
Nedbank Group	Financials
Old Mutual	Financials
Santam	Financials
Medi-Clinic Corporation	Health Care
Netcare	Health Care
Dimension Data Holdings	IT & Telecomms
Anglo American	Materials
Anlgo Platinum	Materials
BHP Billiton	Materials
Exxaro Resources	Materials
Gold Fields	Materials
Mondi	Materials
Sappi	Materials

Source: NBI 2009

Traditionally, the reporting by companies to their shareholders and other stakeholders focused on financial issues. This is changing, and there is an increase in the incidence as well as the volume of reporting of the impact of companies' activities on social and environmental factors. This suggests that accountability to shareholders no longer only in making a profit. Social reporting is considered the first evidence of a company's social responsibility.

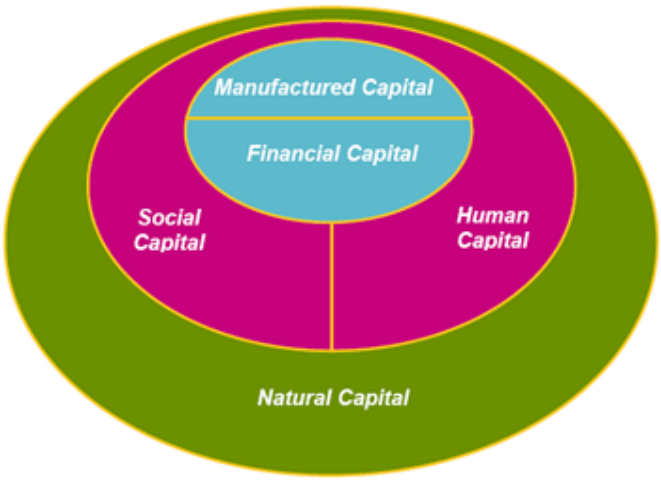
It could be argued that a company will define its CSR activities from its own perspective and, therefore, what it chooses *not* to report may also be of significance to stakeholders. Reporting can be a carefully managed PR exercise and there are calls for third party verification of social reporting. Corporate social reporting could be a sign of change in business practice and it suggests that both shareholders and managers of companies agree that accountability move beyond financial profit. In turn this demand for more transparent and inclusive reporting has also changed the field of accounting. Accountants increasingly need to be able to capture the effects, both positive and negative, of social and environmental activities.

Many factors will impact CSR in the future, such as sustainable development, climate change, demographics, poverty, the power of multi-nationals and changing ideas about corporate governance. Some of these concerns are interrelated; a move towards a more sustainable form of energy can also alleviate pollution, mitigate global warming and might even increase profits. Some authors argue that while CSR elements inside and outside the corporation might have changed dramatically, very little has changed in the design of corporate forms. The dominant culture of the corporation still keeps a focus on short-term benefit to owners, regardless of how remote, passive or transient these owners might be (Kelly & White 2009).

Shareholders of a company might be able to benefit from CSR initiatives, but can never be held personally accountable for their corporation's negative impact on society or the environment. This makes the environmental and social problems caused by corporations hard to solve. The corporate structure enables profits whilst protecting the owners/shareholders from the consequences of making them.

The five capitals model as laid out in the website, Forums for the Future (2010), gives a model for a new way of doing business (see Figure 7 below). This model focuses on what needs to be sustained and enables a holistic view of sustainability. *Natural capital* forms the outer ring and is the delimiter. Sustainability is dependent on the use of resources, waste capacity and the processes of nature. Natural capital will determine how resources should be used and conserved. Financial sustainability should however be achieved as it enables the flow of other capitals but it needs to be achieved by building up rather than depleting the other capitals. *Human capital* refers to individual health, knowledge and skills. *Social capital* is the institutions that enable people to connect with each other. Tradeoffs can be investigated with a view to maximizing each of the capitals depending on the circumstance of the business.

7: The five capitals model



Source: Forum for the future 2010

For a company to adhere to this model it may need to sacrifice short-term profits for long-term benefits. It will also need to believe that working with environmental constraints can be beneficial to operations, that efficient use of resources makes business more profitable, that employees are more productive with optimal working conditions and that the business will function well in a healthy community.

The response to these trends can lead to the emergence of new approaches to the challenges of CSR. These include the professionalisation of CSR, moving beyond ethical sourcing to the whole supply chain, adoption of international standards in supply chains, making CSR more inclusive, increasing responsibility to consumers and growing socially responsible investment. This could ultimately lead to radical transformation of corporate structure and purpose for the enrichment of all stakeholders (Blowfield *et al* 2008).

As the world's largest industry (if revenues were compared to GDP) (Mills 2005), the insurance sector has influence over most areas in the economy and has immense leverage for change.

There is a growing acceptance that sustainable practices could generate additional revenues by inspiring innovation, opening new markets, acquiring and retaining customers, and enhancing brand reputation. It could also reduce costs by improving employee recruitment and retention, reducing commercial risks, and cutting energy use and waste (Goldschein 2010).

Corporate governance in South Africa is regulated by the King Report. King III was released in October 2009. The philosophy of King III revolves around leadership, sustainability and corporate citizenship. This approach reflects global corporate governance priniciples which include emerging trends such as Alternative Dispute Resolution (ADR), Risk-based Internal Audit, Shareholders and Remuneration, and Evaluation of the Board of Directors. King III applies to all entities regardless of the manner or form of incorporation or establishment whether public, private or the non-profit sector.

King III has been written in accordance with a principle-based approach to governance and specifically the "comply or explain" regime, where an institution needs to either comply or explain its non-compliance. This regime was unique to the Netherlands; however, it is anticipated that the Combined Code in the UK will follow this trend in the 2010 update. Whilst this approach remains a hotly debated issue globally, the King III committee continues to believe that it should be a non-legislative code of principles and practices. The non-legislated principle-based approach has stood us in good stead. South African listed companies are today regarded by foreign investors as among the best governed in the world's emerging economies (Seegers *et al* 2009).

Sustainability within organisations in South Africa is still not commonly seen as a core part of the business. Many corporations have sustainability managers and sustainability projects. These are often set apart from the core business. Business continues as usual, with 'green' issues seen as a peripheral necessity. There is a widespread perception that these practices are about 'what we do for the planet' rather than what we are doing to ensure our own long-term existence or the very sustainability of the institution.

It is often thought that CSR will cost corporations money but, in a recent study on the relationship between CSR reporting and financial performance, no correlation, either positive or negative, was found (Cheung & Mak 2010).

CSR reporting will become more important in the future. It is no longer enough to report on *how much* money is made; reporting on *how* the money is made is becoming paramount.

Sustainability within the financial sector in South Africa is still in its infancy. One bank in South Africa, Nedbank, has become carbon neutral and promotes itself as "green" in its marketing campaigns. The second phase of their headquarters in Sandton, Johannesburg was the first building in South Africa to get the rating of Green Star building under the Green Building Council of South Africa's (GBSA's) rating tool (Swanepoel 2009). Nedbank does not have a SWH programme running through either its bank or its insurance arm. They are, however investigating the possibilities in this regard.

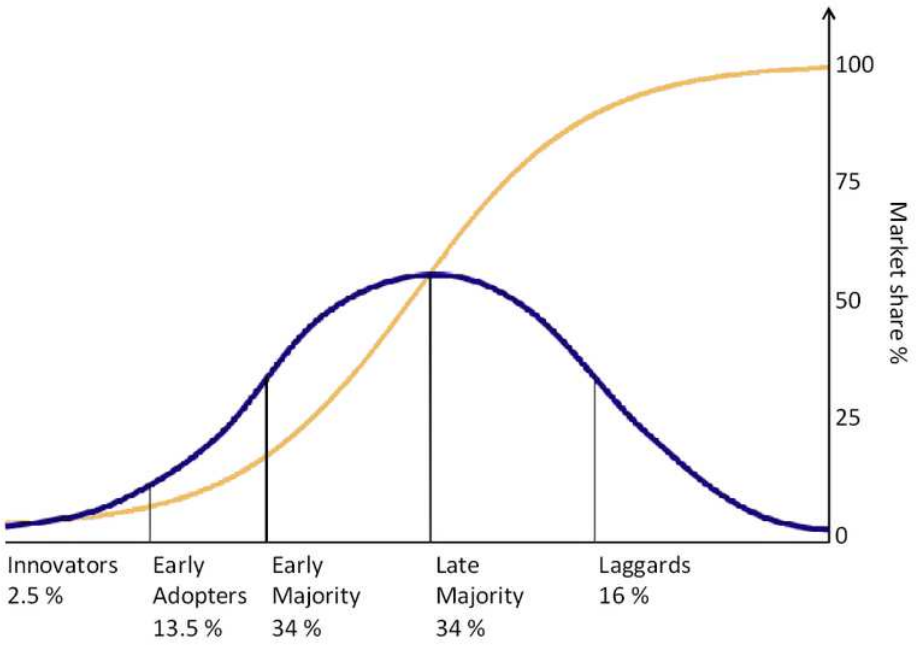
Santam Insurance has had a SWH pilot programme running from their claims department since 2009. They rolled out this programme countrywide in the beginning of 2010. Santam was in addition rated the best employer in the large company category as rated by their staff in the 2009 Deloitte Best Company To Work For Award (Santam 2009).

2.5 Diffusion of technology

Diffusion refers to the spread of a product within a market. It is considered to be a function of the technology, communication and the social environment.

"Diffusion of Innovations" (Rogers 2003) is a theory of how, why, and at what rate new ideas and technology spread through cultures, represented schematically in Figure 8 below. Successive groups of consumers adopting the new technology is shown in blue and the increase in market share is shown in yellow.

Figure 8: The diffusion of innovations

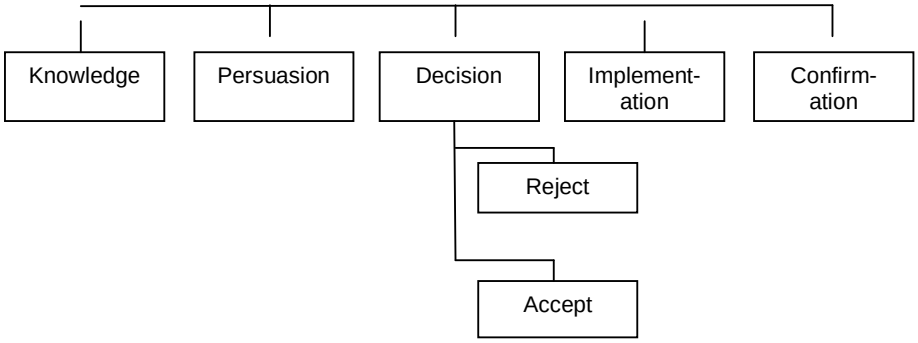


Source: Rogers 2003

Even though SWH technology can no longer be classified as a new idea, the Diffusion of Innovations theory could be held to be applicable because the idea has not yet spread through South African society. There is, however growing interest in the technology from government, business, the financial sector and private individuals.

The Diffusion of Innovation process is described in terms of five stages in the adoption process, shown in Figure 9 below.

Figure 9: Five stages in the decision innovation adoption process



Source: Rogers 2003

The stage where a person first becomes aware of an innovation is the knowledge stage. In this stage there is very little active connection with the innovation. The persuasion stage describes the part when the person decides if he/she likes it or not. In the third stage, the individual decides to either adopt or reject the innovation. If the individual adopts the innovation, he/she moves to the fourth stage and uses the innovation. The process is completed when the individual confirms that the innovation meets his or her needs.

There are five characteristics that lead to a product having fast diffusion in a market. These are: relative advantage over alternatives, compatibility, complexity, trialability and observability (Rogers 2003). The more of these five factors that are present, the greater the likelihood for faster diffusion in a market. When this theory is applied to SWH technology, it emerges that four of the five attributes for fast diffusion are present; SWHs have definite relative advantages over alternatives, are compatible, are quite simple and are highly observable when mounted on a building's roof.

The only characteristic that SWH technology does not have in this regard is trialability. In practice, a SWH cannot be tested before deciding to accept or reject it. However, when SWHs are used in demonstration projects, the public has the opportunity to observe their use and productivity and this could act as a proxy for individual testing.

The five-stage model for the adoption process is useful for understanding the thought process that people undertake when making a purchasing decision. In the case of a technology such as a SWH, which is not easily interchangeable and thus requires a bigger upfront commitment from the individual, extra care needs to be taken to convince the individual of the benefits, reliability and efficiency of the technology. Besides the potential to test the performance of SWHs through

observation of demonstration or pilot projects, early adopters' experiences are also useful in persuading potential new consumers.

Rogers (2003) also promoted the use of opinion leaders and change agents to accelerate the acceptance of technologies. Opinion leaders are different from innovators in that, "opinion leaders have followers, whereas innovators are the first to adopt new ideas and are often perceived as deviants from the system's norms (Rogers 2003:388). Change agents create demand for a product or innovation by reducing obstacles for uptake, persuading adopters and supporting uptake decisions. Change agents are most effective when they work with opinion leaders, who have a higher status and are more innovative than their peers.

2.6 Innovation theory and socio-technical systems theory

A new product can reach different consumers at different times and through many different methods. An understanding of the phases of penetration of a new technology into the market is useful in research (and in practice), not necessarily to forecast the transition in time, but to be able to recognise the phases and, in so doing, be able to help consumers to move in a desirable direction, for example towards more sustainable forms of development or adopting renewable energy technology (Grin *et al* 2010). A number of innovation theories that describe the phases of penetration of new products are discussed here.

According to Crawford (1997), consumers of new products move through four stages of experience: awareness, trial, availability and repeat use. Consumers only become willing to test a product after they are aware of the product, and there is a need to have it readily available for testing. If the test is successful, the consumers can be expected to use the product again. The new product development model could be used by companies to find out what prevents potential customers from adopting a SWH, and to suggest the most appropriate methods of getting those consumers to move in stages from awareness to the installation of a SWH. There would be less emphasis on frequent repeat use because SWHs have a long expected lifespan. Unless the consumer is very unlucky or bought a very low quality system, it can reasonably be expected that any future purchases should be SWHs rather than a standard water heater.

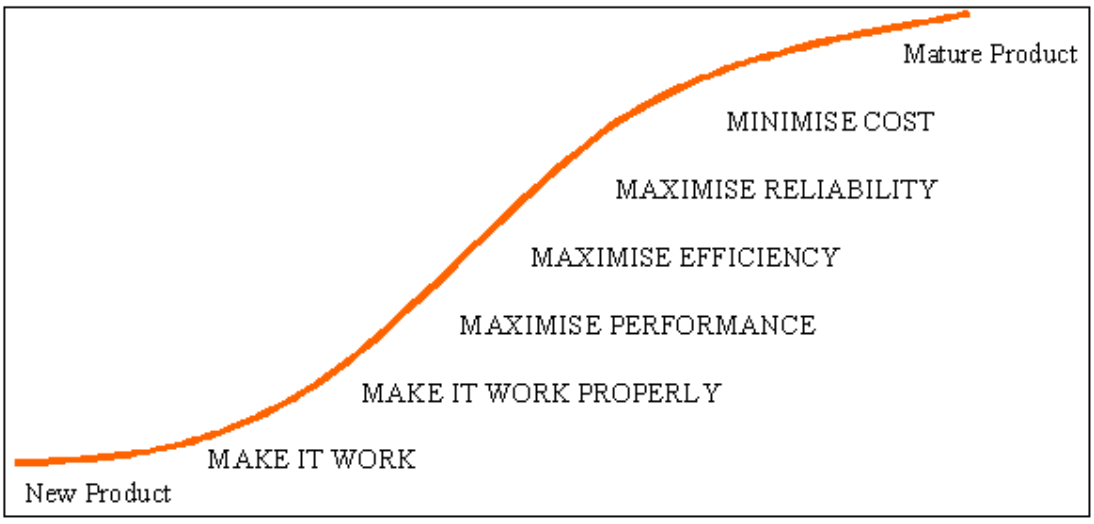
The position of a potential consumer relative to the first three stages of Crawford's (1997) model is a useful indicator for marketers because it helps them to identify what is needed to move the consumer from awareness to trial. At this stage, marketers need to propose an appropriate claim for the product and test the reaction of consumers to the claim. The specific barriers which prevent a person from testing a product can be identified and overcome using to Crawford's (1997) theory

of ten typical consumer barriers to trial, as follows:

- Lack of interest in the claim
- Lack of belief in the claim
- Belief of something negative about the product
- Complacency
- Competitive ties
- Doubts that trial will tell them what they really would like to know
- Lack of usage opportunity
- Cost of purchase and use
- Routine, automatic buying and consuming systems
- Risks of rejection or failure

Even though SWH technology is not new, because of the severe lack of interest in this technology in South Africa in the past, Mann's (1999) S-curve of invention might be an appropriate way of looking at the future of the technology. The 'S' refers to the shape that the market penetration takes over time. When a new innovation enters the market, it takes time for penetration to grow. After a length of time, if the product is accepted by the market, market penetration then grows rapidly and, once it reaches full market potential, penetration stabilises. This is elaborated in Figure 10 below, showing that a new technology usually grows quickly when it is made to work properly and its performance, efficiency and reliability is maximised. As the product matures, ways of minimising the cost could be introduced.

Figure 10: Typical invention-focus S-curve



Source: Mann 1999

This way of looking at the penetration of a technology into the market could be defined as multi-phase. Over time, there are four phases, namely the pre-development phase, the take-off phase, the acceleration phase and the stabilisation phase. This concept is rooted in the theory of complex adaptive systems (Grin *et al* 2010).

Because the performance, efficiency and reliability of SWH technology has already been maximised worldwide, and because it is a technology that is known to work, it is clear that, in South Africa, the problem with SWH penetration cannot be explained by the S-curve model. This might be because of the history in South Africa of abundant cheap electricity in comparison to the relatively high capital cost of SWHs. This scenario is changing, as a result of the rising price of electricity, and the decreasing cost to the consumer of SWH installations due to higher demand as well as government subsidies. It might be that the popularity of SWH technology will rise because of this price phenomenon or because of increased marketing influencing consumer perceptions of product reliability, efficiency and performance.

Consumer readiness is defined as a condition where a consumer is prepared to use an innovation for the first time (Meuter *et al* 2005). Readiness is defined as a combination of motivation, clarity and ability. In the case of SWHs, it is important to look at the consumer's motivation for making the change from a standard water heater, the accessibility of finance, and the clarity of the SWH as a product. This will determine the state of readiness of the consumer. Holm (2005) noted that officials who promoted SWHs seldom installed them in their own homes. He goes on to say that almost all SWH initiatives have been formulated as a technical or, at best, as a techno-economic solution and there was no attempt at integrated or inter-disciplinary research or planning, nor has Solar Water Heating been integrated with water demand management.

Another, system-based, interpretation is possibly more useful in the South African context. Garud & Karnoe (2001 in Grin *et al* 2010) describe the situation where there is "lock-in" because of path dependence. In terms of this theory, the transition to adoption of an innovative product is surrounded by uncertainty and complexity, and there is a low predictability. This theory of lock-in because of path dependence provides a useful model for understanding, and possibly influencing, the complex system of technology change.

Van der Brugge & Rotmans (2006) describe a transition path where an innovation or new technology gains some influence in the system, but does not completely replace the existing technology and, as such, co-exists with it in a "locked in" state. Grin *et al* (2010) also propose that the adoption of innovative products is inhibited by processes which are firmly embedded in societal structures. Because of this, the removal of barriers to adoption will involve innovative practices as

well as structural adaptation. Such profound processes of change are referred to as "system innovations" and "transitions".

Geels (2004b) explains that systems are often "locked in" on multiple levels. These include economic reasons, and also cultural, infrastructural, social and regulatory factors. The systems within which the SWH industry is located are stable and very difficult to change. This opens up the analytical focus to what he describes as socio-technical systems.

The standard water heater market and its relationship with the insurance industry can be described as a stable system. The system works very well in selling a particular product in a particular (and very effective) way for the benefit of a particular set of interests. To influence this system, a good theoretical understanding of the system in necessary. It could be said that the system is "locked in" to replacing failed standard electric water heaters with new standard electric water heaters. This is partly because of financial reasons (the initial cost of a standard water heater is lower than a SWH), social reasons (SWH technology is not fully understood nor trusted) and infrastructural reasons (the plumbers contracted to the insurance companies are trained to install standard water heaters / standard water heaters still dominate the South African market).

To understand this complex socio-technical system better, the multi-level perspective described by Geels (2002, 2004a, 2004b) and further expanded on by Grin *et al* (2010) is useful. According to Grin *et al* (2010), transitions have the following characteristics:

- Transitions are co-evolutionary processes that necessitate many changes in socio-technical systems or arrangements. Both the development of technical innovations as well as their use are involved in this. This includes the markets and use of the product, as well as regulations, markets, infrastructure and cultural symbols.
- Transitions are multi-actor processes. This entails dealings between social groups such as businesses, different user groups, scientific communities, policymakers, social movements and special interest groups.
- Transitions are radical shift s from one system to another. Here the term "radical" refers to the scope of change and not the time frame.
- Transitions are long-term processes of 40 to 50 years.
- Transitions are macroscopic and are analysed on the "organisational field" as described by DiMaggio & Powel (1983 in Grin *et al* 2010). This "organisational field" comprises the entire institutional life, such as key suppliers, all consumers and regulators, as well as other organisations producing similar products or services. This form of analysis makes sure that the totality of the relevant actors are incorporated.

Transition as a concept has been studied in several disciplines for decades: biology and population dynamics in economics and sociology; political science in science and technology studies and systems sciences; but none of these is applicable to the complex nature of societal transformations implicated in sustainable development (Grin *et al* 2010).

From the transition perspective, crises can be seen as an opportunity for change because they challenge existing institutions, causing many to embark on a quest for new values and norms. Transitions towards sustainability might also be described as a quest for new value systems. Transitions include multi-layered concurrent changes in practice and structure; they bring about changes in entrenched societal systems and cultures and, because of this, they are very complex processes.

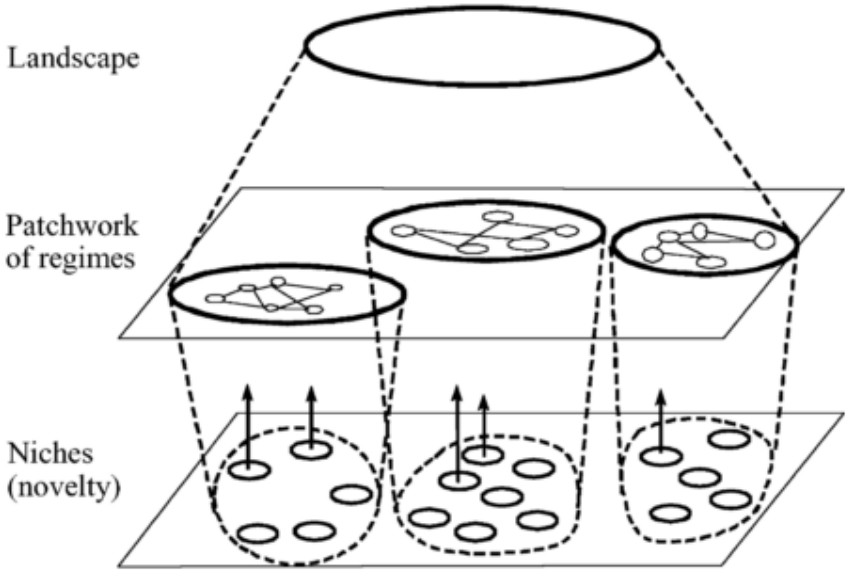
Geels (2005) describes system innovations as co-evolutionary processes as they involve both technological changes as well as changes in other elements. He goes on to say that there are many new technologies with better environmental performance than existing, entrenched technologies, yet, they are not being taken up.

The multi-level perspective on transitions described by Geels (2004b) enables better understanding of transitions from one socio-technical system to another. In this theoretical framework, he describes three layers of a socio-technical system; namely the landscape, the regime and niches. The “niches” are the places where innovations happen. These are typically protected from mainstream market selection and act as incubation rooms for new and innovative (or radical) technologies. These niches are necessary because new technologies are often characterised by low performance and are expensive (think of the early days of cell phones). Niches are very important because they create space for learning (as well as learning by doing). The “regime” refers to the rules of different social groups. Socio-technical regimes provide stability to the system. This stability is dynamic and supports innovation but often only of an incremental nature. The socio-technical “landscape” refers to the external structure or context within which the regime functions. It includes broader external factors, whereas the regime refers to the rules that constrain and enable activities in communities. As an example, the landscape could refer to factors such as the price of electricity, economic growth and environmental problems.

These three layers could also be described as innovative practices (niche), structure (the regime) and long-term, exogenous trends (the landscape) (Grin *et al* 2010). It must be noted that these levels are conceptualised as functional levels of scale and not as spatial levels. Although change happens more slowly at the higher levels, the relationships between levels are closely interwoven. Only once the different dynamics come together in very particular ways will a mutual reinforcement effect emerge; this is a condition which is necessary for transition to take place.

The multi-level perspective is represented in Figure 11 below.

Figure 11: Multiple levels as a nested hierarchy

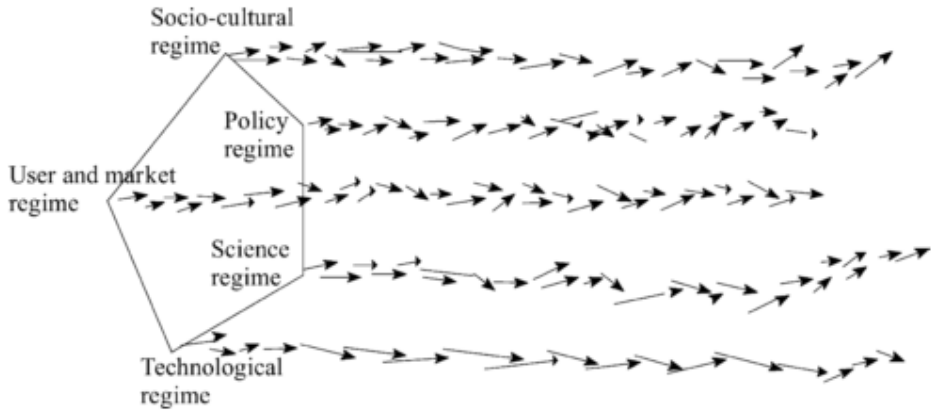


Source: Geels 2002

The rules of socio-technical regimes give stability to socio-technical systems and thus also account for their lock-in. Organisations are resistant to major changes because they develop "webs of inter-dependent relationships". Rules and routines can make designers and engineers reliant on particular solutions and, in so doing, they do not see new developments that are emerging outside their immediate area of focus (Nelson & Winter 1982 in Grin *et al* 2010). Contracts, technical standards and government subsidies may in addition favour existing technologies.

Predictable paths do not only occur in the technological sector. They are present also in the evolution of policy, science, industry, culture and markets. The different sector groups are relatively autonomous, sharing particular perceptions, norms and preferences internally and experiencing their own dynamics. For the functioning of socio-technical systems, different groups interact and form networks. Social groups overlap in some manner without losing their identity. Because of this, different socio-technical systems co-evolve (Figure 12).

Figure 12: Alignment of trajectories in different regimes



Source: Geels 2004a

The timing of landscape pressure on regimes with regard to the state of niche developments are crucial. If the landscape level puts pressure on the regime before the niche innovation is fully developed, the path will be different to what it would be when the innovation is fully developed. The development of the niche innovation is often not objective and the view of this will differ between actors (Grin *et al* 2010).

Grin *et al* (2010) proposes the following as necessary conditions for viable niche innovations to be able to break through and be accepted more widely:

- The learning process has stabilised and there is a dominant design.
- The support network has been joined by powerful actors.
- The price and performance has been improved upon and there are strong expectations of further improvements.
- The innovation is already used in market niches. These niches add up to more than 5% of the market share.

Statistics on the sale of SWHs in South Africa are difficult to access (Holm 2010, Worthman 2010) and it is thus difficult to establish the market penetration of SWHs. Using statistics from 2005 (Holm 2005), it is likely that SWHs occupy just over 5% of the total water heater market (Schultz 2010). The learning process for the SWH industry has stabilised and there is a dominant design, the price and performance has been improved upon. If the support network for SWHs are being joined by more powerful actors, all the prerequisites according to Grin *et al* (2010) will be met for SWHs as a niche innovation to be accepted more widely. According to this theory therefore, SWHs stand a good chance to become the dominant technology.

Niche innovations that are still in early stages of development usually do not pose a threat to the regime (Grin *et al* 2010). If the regime is dynamically stable, radical niche innovations may be present but have little chance to break through. If the shared perception is that the regime has sufficient problem-solving potential to deal with problems, the internal problems will not pose a threat to the regime. Stable regimes are still dynamic. Firms compete in markets and investment is made in new product development. These processes, however, occur within a stable environment and in predictable directions. Accumulated incremental innovations in stable regimes can boost performance.

Grin *et al* (2010) describes six ways in which transition takes place.

1. *Transformation path*. If niche innovations have not yet been sufficiently developed at the time when there is moderate landscape pressure, regime actors will modify the direction of development paths and innovation activities. New regimes will grow out of old regimes through cumulative adjustments and reorientations. Some changes may occur, but mostly regime actors survive.

2. *The de-alignment and re-alignment pathway*: If the landscape change is large, divergent and sudden, then regime problems may cause the regime actors to lose faith. This leads to de-alignment and erosion of the regime. If the niche-innovations are not developed enough at this point, there is no clear substitute for the regime. Multiple niche innovations will then compete for attention and eventually one will become dominant and develop into the new regime.

3. *The technological substitution pathway*: If the landscape pressure is large at a moment when niche innovations have developed sufficiently, they will break through and replace the existing regime.

4. *Reconfiguration pathway*: Symbiotic innovations, which developed in niches, are adopted by the regime to solve local problems. These innovations can easily be adopted as component replacements or add-ons. In this transformation path, the basic architecture of the regime remains the same.

5. *Mixing pathways*: If landscape pressure takes the form of “disruptive change”, a sequence of transition pathways is likely. It will begin with transformation, followed by reconfiguration and often then followed by substitution or de-alignment and re-alignment.

The terms disruptive innovation or disruptive change refer to an innovation or process that disrupts an existing market. The terms are used to describe innovations that improve a product or service in unexpected ways.

The replacing of failed water heaters with SWH via the insurance industry, who oversee procurement and installation of most of the failed water heaters in South Africa (Schultz 2010),

could be seen as a disruptive innovation. It is a completely new way of dealing with an old problem, from new procurement routes and installers, to financing of the systems and dealing with government subsidies and carbon credits as well as the implication of insuring the newly installed systems.

Many established companies struggle to innovate successfully, be it with new products, systems or procurement. Most of these companies have many talented people in their employ but these people work on new opportunities within organisational structures which are designed to overcome old challenges and not the new challenges that the company might be facing. The problem does not lie with managers not seeing disruptive changes coming; the changes are often foreseen. The companies often have resources and enough capable people working on the change. The problem often does not lie with the individuals working on the change either, but with the organisation itself.

Three factors often affect where an organisation will succeed or not; these are the organisation's processes, its resources and its values. Managers need to take a good look at these factors and work out how each of them might affect their organisation's capacity for change.

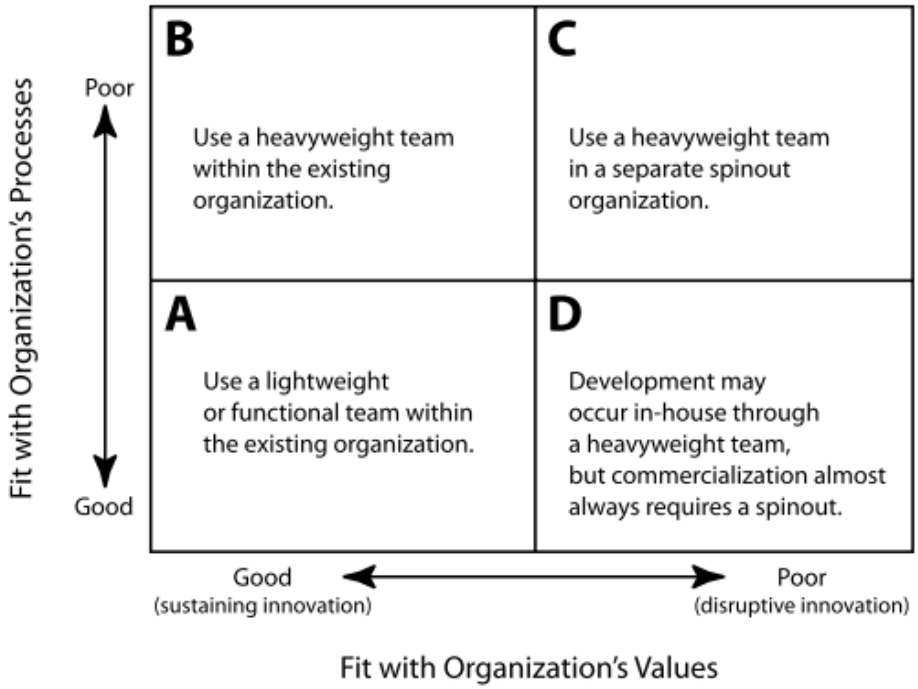
Processes within a company are often set up so that employees perform their tasks consistently. These processes are usually set up to resist change or to only change through very specific, controlled procedures. The values within an organisation will also affect its capability to change. Here the word "values" is used with the broad understanding as the standards by which employees set priorities that enable them to judge whether an order is attractive or unattractive, whether a customer is important or less important or whether the idea of a new product or process is worth investigating. These prioritising decisions are made by employees at every level within the company (Christensen & Overdorf 2000).

Successful companies are usually good at responding to evolutionary changes in their markets, which could be referred to as sustaining innovation. The same companies, however, often struggle when dealing with disruptive innovation. The roll out of SWHs in the place of standard electric water heaters via the insurance industry at point of water heater failure can be seen as a disruptive change. For transition to occur entrenched habits need to be changed and new processes put in place. Finding new procurement routes is just a part of the solution. Convincing the policyholders to change also forms part of it. This change will struggle to happen within existing structures.

The matrix in Figure 13 is a management tool for understanding what type of team should be deployed on a specific project, and which organisational structure that team needs to work from. The vertical axis measures the extent to which the organisation's processes will get the new job

done. The horizontal axis measures whether the organisation's values will allow the company to assign the necessary resources that the new programme requires.

Figure 13: Fitting the tool to the task



Source: Christensen & Overdorf 2000

In region A, no new capabilities are needed as the project is a good fit with the company's existing processes and values. A functional or a lightweight team can tackle the project within the existing organisational structure. A functional team works on function-specific issues, then passes the project on to the next function. A lightweight team is cross-functional, but team members stay under the control of their respective functional managers.

In region B, the project is a good fit with the company's values but not with its processes. It presents the organisation with new types of problems and requires new types of coordination and interaction among individuals and groups. This team is working on a sustaining rather than a disruptive innovation. Here a heavyweight team will work better, but the project can be executed within the mainstream company.

In region C, the manager faces a disruptive change that doesn't fit the organisation's existing processes or the existing values. To ensure success, the manager should create a spinout organisation and commission a heavyweight development team to tackle the challenge. The

spinout will allow the programme to be ruled by different values, for example a different cost structure, which might have lower profit margins. The heavyweight team will ensure that new processes can emerge.

In region D, when a manager faces a disruptive change that fits the organisation's current processes but doesn't fit its values, the key to success almost always lies in commissioning a heavyweight development team to work in a "spinout", or separate business unit set up for this innovation. Development may occasionally happen successfully in-house, but successful commercialisation will almost definitely require a spinout. Ideally, each company should tailor the organisational location, as well as the team structure to the process and values required by each programme (Christensen & Overdorf 2000).

2.7 Chapter Summary

The literature review served to develop the researcher's understanding of the complex system of both the SWH industry in South Africa and its potential interaction with the insurance industry. Literature on different approaches to these systems was considered.

The extent penetration of SWHs differs immensely between countries around the world. The most popular policy approaches that have been used by governments to promote SWH penetration are subsidies and mandatory obligations but, in some cases (such as Cyprus), SWH technology has a high penetration without mandatory obligations or subsidies.

Climate change will affect the financial services sector in the future. Insurance companies are risk managers and the effects of climate change will impact on their future business. For these reasons, insurance companies need to be aware of climate change and ways of mitigation. In addition, carbon financing could be seen as a tool for financial incentivisation of carbon emission reductions. The installation of SWHs will reduce domestic electricity use and carbon emissions. If the insurance industry rolls out a SWH programme, carbon financing could be used as a tool to reduce the cost to the policy holders.

It is becoming more important for businesses to ensure that they make profits in ethical ways, and corporate social responsibility (CSR) as well as CSR reporting is being taken more seriously by businesses. This includes businesses that are responsible for infrastructure investments, such insurance companies that install water heaters on behalf of their policy holders.

New technologies often do not make it to the market. This is not related to how efficient they are or how well they are priced but rather to how the system works. The S-curve model for diffusion of

technology provides a theoretical approach as to how technologies enter the market and become main stream. It does not, however, provide much insight into why a new technology fails to flourish in the market even if all the prerequisites are in place.

The Dutch literature on technological change provides a theoretical background with which the complex system of the SWH industry as well as the interaction with the insurance industry in the South African context can be appreciated.

The argument that emerges from this literature is that transitions happen at three levels:

- The **landscape level** incorporates the macro-system dynamics such as industrialisation, resource-intensive growth, energy price and ecological degradation.
- The socio-technical **regime** is where specific technologies become mainstream. This is where everything happens to reproduce these technologies (for example coal-fired power stations or, as in this case, standard electric water heaters).
- The technological '**niches'** is where alternative networks come together around new technologies (such as SWH). Landscape pressures for change (for example, the ecological crisis) do not automatically force regime change because, at the regime level, there might be a technological 'lock-in'. A technological transition is dependent on niche innovations that have matured to a point where they can provide the basis for an alternative regime. In the case of SWHs, it will entail a new financial, regulatory, institutional and technological configuration for delivering the new technology. The existing systemic logic has been finely tuned to deliver one particular technology and cannot merely be used to deliver a different one.

Chapter Three: Financial options

3.1 Introduction

The upfront cost of a SWH is significantly higher than that of a standard electric water heater but, due to the reduced electricity requirement, the running cost of a SWH is significantly lower. The change over to a SWH thus requires a different way of thinking about the cost.

If there is an insurance contract, the insurance company has an obligation to the policyholder to the value for which the property is insured. It follows that the policyholder can only be covered to the same extent as the damage and not for a higher value. It would be contrary to insurance regulations to supply a policyholder with a product that is significantly higher priced than the product that has failed (Genis 2010b), as in the case of a SWH in the place of an electric water heater. This need not be an obstacle for the insurance industry to become involved in the changeover to SWHs. It is possible for an insurer to replace a failed or stolen item with a higher priced product if the difference is paid by the policyholder. As the policyholder will get the benefit of the reduced electricity use from the SWH, it should be possible to convince them to pay a contribution towards this change. The difference between the price of the SWH and the price of the electric water heater might in addition be carried by a third party, such as a government subsidy. The difference could also be bridge-financed by the insurer or a third party.

In this chapter it will be shown that the change to a SWH at point of water heater failure should be financially beneficial for both the policyholder and the insurance company.

3.2 Financial options for the policyholder

One of the main barriers to the uptake of SWH worldwide has been identified as the high upfront capital cost (Holm 2005). A SWH costs more than a standard water heater, but saves money in the long run due to the electricity saving. With the current prices of SWHs in South Africa and the rising price of electricity, it is financially beneficial for most consumers to install a SWH. If the added benefit of the current system of subsidising plus a payout from insurance for a failed standard water heater is added, the installation of a SWH makes complete financial sense. It has however been noted by Milton *et al* (2005) that even though SWH prices in South Africa are competitive from a global perspective, locally they are still perceived as unaffordable for many households.

There are many finance options in the market for the serious buyer of a SWH. The problem with financing though, is that it becomes cheaper the less you need it. In the South African context, money is available to high-income earners at the prime lending rate minus two percent. Middle-income earners have a more limited access to credit, at the prime rate. Low-income earners have the least access to finance and could pay as much as prime plus about 25 percent interest per year. Interest rates on credit cards range from between six to about ten percent above the prime lending rate.

Many consumers who might consider borrowing money to pay the up-front cost for SWH equipment may be unable to do so due to their limited or bad credit history or the lack of understanding of SWH technology by the banks.

Most homeowners in South Africa have homeloans registered on their properties. Many of these loans are flexible and it is possible to extend them without too much cost, paperwork and administration. Due to the stringency of the National Credit Act, it is, however, often difficult to extend the loan if the homeowner has not had contact with his bank for a some time and the credit rating of the homeowner needs to be looked at afresh. It is often possible for a homeowner to buy a SWH on an existing credit card. This does, however, affect the card owner's available credit. Some financial institutions in South Africa are investigating the possibility of a "green" credit card, which would be made available to a homeowner and would provide access to finance for any kind of "green" purchase for their home (Botha 2010). What specific purchases such a card is used for is, however, difficult to control, in much the same way in which it is difficult to control for what an extension of a home loan is used. A "green" credit card could be used for marketing purposes by a bank and will affect the homeowners credit availability in much the same way as any other credit purchase, and the availability of credit for other uses will be reduced accordingly. There is no mechanism in South Africa at present for the saving of electricity due to the installation of a SWH to be taken into account in the credit rating used to evaluate a customer's access to credit.

Some international financial institutions are starting to rank customers according to their purchases. The theory is that a person who purchases a SWH would be a type of person who thinks about the future, is concerned about the environment and will take a long-term saving before short-term gain. Such a person would be a safe, dependable and thus desirable client for a financial institution and could be offered loans at preferential rates (Holm 2010). The appetite for this kind of scheme in South Africa was found to be very low (Botha 2010, Kuhn 2010). The financial institutions need statistics as proof of this and it does not exist in the South African context.

Even though the initial capital and installation cost of a SWH is considered to be high, it is not such a big capital outlay that a small change in the interest rate charged for the financing really matters

that much. A one percent difference in the interest rate on a loan of R15 000 will only make a difference of R12.50 in the monthly payback premium.

Some municipalities are investigating financing options for ratepayers who wish to install SWHs. Most notably is the Nelson Mandela Bay Municipality where it is proposed that the roll out of SWHs will be financed by the Central Energy Fund (CEF) and the repayments done via the municipal services billing system. Ekhurhuleni District Municipality are also working with the CEF on a plan for the mass roll out of SWHs in which repayments will be done via the monthly municipal bill (S van der Merwe 2010). The City of Cape Town is investigating similar options (Roggen 2010). If these programmes are implemented successfully, it will be of huge benefit to the municipalities concerned due to the reduction of peak load electricity demand. It will also hugely benefit the ratepayers concerned as it will lighten their financial burden due to the repayments to the municipalities being lower than the electricity saving incurred due to the SWH installation. In addition, it will be a secure financing option for the financier, as the municipalities have the full payment record of the homeowner and in addition have the ability to cut the electricity of a defaulting customer.

Teljoy is a rent-to-own finance company that has been operating in the South African market since 1969 and have recently moved into the SWH market. Teljoy offers a flexible SWH finance option at prime plus five percent. Teljoy in addition finances and administers the Eskom subsidy on behalf of the SWH buyer (Teljoy Solar 2010).

There are many other new players in the SWH market with various rental or rent-to-buy options. Most offer a comprehensive maintenance plan and flexible down payment and payback options and charge a finance fee of between five and ten percent above prime lending rate. Some even include a credit option for the full price of the SWH plus installation cost. The customer then claims the SWH subsidy themselves and when received, it is cash in their pocket. This is seen as a benefit to many cash-strapped consumers. Some innovative businesses have structured the loan for the capital cost of the SWH to increase annualy with the price of electricity but at a lower rate. There are companies which offer rental of SWH units where the monthly rental is lower than that of the saving in electricity. The rental increases annually but at a lower rate than the electricity increase (Solarent 2010). In this way a SWH can not only be installed with no extra cost to the consumer but in fact delivers a saving from day one.

There are 1 473 different SWHs listed on the Eskom DSM website ranging in price from R10 000 to R30 000. Many of these installations are not really different units, but just permutations of similar products. Installation costs are between R2 500 and R6 000 (Eskom Media Desk 2010). The installation cost is not only dependant on the system chosen. The roof type, orientation and the

angle of the roof will also affect it. The Eskom subsidy ranges from R2 000 to R12 000 per system according to the efficiency and performance output of the unit (de Bruyn 2010). Not only will the electricity savings gained from the installation of a SWH differ according to the system chosen but this saving is also dependent on the hot water usage of the occupants of the house. All of the above variables make it very difficult to talk about an the average cost of a SWH or average cost of installation as well as an average saving of electricity.

The financial calculations below are done over a seven year period. SWHs have a minimum manufacturer's guarantee of five years but will most probably last much longer. When the SWH does eventually fail, it is unlikely that the solar collector and the storage unit will fail at the same time. As the SWH forms part of the building, it will be insured and will thus be replaced by the insurer. There is some concern for insurers about the hail insurance for units which do not carry a manufacturer's guarantee against hail as it is not clear whether an insurer will be liable for replacement of these (de Ridder 2010a).

If the hail damage on the units is covered by insurance, it will push up the risk and have an influence on the premium price. It is unlikely though, that one insurer will push up the premiums significantly for homes with SWH installed. Homeowners in areas where hail often occurs are likely to be aware and install units that are hail-resistant. These units will be covered by the manufacturers guarantee. If the water storage for the SWH is installed on the rooftop, this will reduce the claims significantly as there will be no resultant damage to the property in the case of a failed tank. This could reduce the premiums significantly. Again, it is highly unlikely that an individual insurer will lower the premium on homes with SWH in the near future (Harkema 2010c, de Ridder 2010a). At present, a policyholder is very seldom asked about the amount or type of water heater installed in the house when taking out an insurance premium. Due to all of the above, the theoretical future increase or decrease in policy premium due to a SWH installed on the roof will not be taken into account in the financial calculations.

The SWH owner will keep realising electricity savings for as long as the SWH is used. This saving will increase as the electricity price increases and the lifecycle benefit will thus most probably be a great deal more than the benefit calculated over seven years. The return on investment (ROI) in the calculations below is taken over seven years to show that, even without any form of subsidy or a capital benefit from the insurance payout of a failed water heater, the breakeven point occurs within seven years for all cases investigated.

As examples, two SWH were taken; a high-end SWH at R23 000 and R4 000 installation cost and a lower-end SWH at R15 000 and installation cost of R2 500. Installation cost is dependent on the type of SWH, the roof structure as well as personal preferences of the homeowner. A consumer

who chooses a higher priced SWH will probably also choose a more expensive installation for aesthetic reasons. The Eskom subsidy for the higher priced SWH is taken as R12 116 and the Eskom subsidy for the lower priced unit is taken as R4 000. The standard offer programme is taken as R1 296 per year. Capital cost to the owner is taken as the cost of the SWH plus the installation cost less the Eskom subsidy (in the case where it is considered). Total cost to the owner is taken as the capital cost plus a yearly interest of 8% plus maintenance fee of R1 200 every three years. The insurance pay out was taken as R5 700 for the higher end system and R4 800 for the lower end system. A water heater that is replaced by a more expensive SWH, would most probably also have been a more expensive water heater in the first place. The calculations were done with current market prices. It remains to be seen whether the price of SWH and the price for installations will go up or down as demand increases or whether the insurance industry could negotiate lower prices with mass roll out. The monthly electricity saving was taken at 350 KWh per month for the more expensive unit and 250 KWh per month for the cheaper one. Added justification of these figures is provided in Appendix 3.

As the price of carbon in the voluntary market or with CDM is not fixed and the future of these are uncertain, a carbon credit was not considered in these calculation. Should a programmatic CDM, however be registered for these SWH to be installed, this would bring the price down even more. This benefit could be transferred to the policyholder in the form of a capital cost reduction or a discount on the insurance premium. This carbon credit could also be taken as payment for maintenance on the system and the SWH owner then gets the maintenance “for free”.

The breakeven point for ROI for the installation of a SWH instead of a standard water heater is at worst somewhat over six years, as can be seen in Table 8. When a subsidy (either the Eskom subsidy as it stands now or the SOP) and an insurance payout are taken into account, the breakeven point is brought back down to just over a year. This is the point at which the capital cost has been recovered. After this, the saving still carries on and increases yearly with the electricity increases.

Table 8: Breakeven point for SWH

	Capital cost to owner at installation	Maintenance cost - year 3 and year 6	Electricity saving	Break even reached at:
High end SWH / no subsidy / no insurance benefit	R 27,000.00	R 1,200.00	350 KWh / month	4 years 6 months
High end SWH / no subsidy / with insurance benefit	R 21,300.00	R 1,200.00	350 KWh / month	4 years
High end SWH / Eskom subsidy / no insurance benefit	R 14,884.00	R 1,200.00	350 KWh / month	2 years 6 months
High end SWH / Eskom subsidy / with insurance benefit	R 9,184.00	R 1,200.00	350 KWh / month	2 years
High end SWH / SOP / no insurance benefit	R 27,000.00	R 1,200.00	350 KWh / month	4 years
High end SWH / SOP / with insurance benefit	R 21,300.00	R 1,200.00	350 KWh / month	3 years 6 months
Lower end SWH / no subsidy / no insurance benefit	R 17,500.00	R 1,200.00	250 KWh / month	3 years 6 months
Lower end SWH / no subsidy / with insurance benefit	R 12,700.00	R 1,200.00	250 KWh / month	2 years 6 months
Lower end SWH / Eskom subsidy / no insurance benefit	R 13,500.00	R 1,200.00	250 KWh / month	3 years 6 months
Lower end SWH / Eskom subsidy / with insurance benefit	R 8,700.00	R 1,200.00	250 KWh / month	2 years 6 months
Lower end SWH / SOP / no insurance benefit	R 17,500.00	R 1,200.00	250 KWh / month	3 years 6 months
Lower end SWH / SOP / with insurance benefit	R 12,700.00	R 1,200.00	250 KWh / month	2 years 6 months

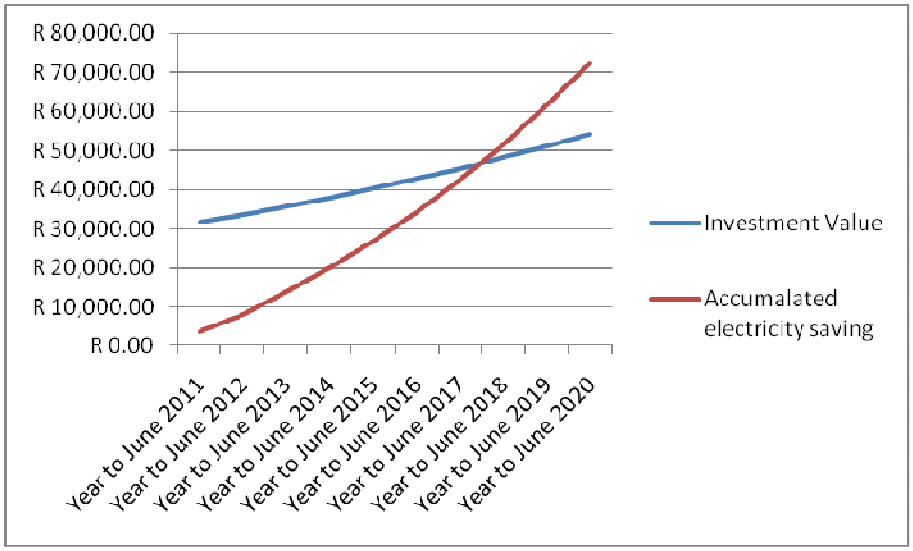
There is a financial benefit for a homeowner at present in South Africa to install a SWH even if there is no financial support from government or an insurance benefit due to a failed water heater, as demonstrated in Table 8. It is also obvious from these figures that if a government subsidy as well as an insurance benefit is included, the financial benefit increases and it becomes an extremely financially beneficial option to take.

The ROI for installing a SWH is attractive. Homeowners who have spare cash to invest should be actively encouraged by their financial advisors to invest in a SWH. Not only should it increase the value of their property, but the benefit from electricity saving is tax free and will increase every year as the electricity increases. The homeowner will often even be able to take the SWH with when they move. If the SWH is SABS approved, their investment is guaranteed by the manufacturer and

installer for at least five years and after that it is insured as part of the property by default if they have homeowners insurance.

In Figure 14 below, a R30 000 cash investment at six percent after tax interest is compared to the installation of a SWH. The electricity saving was taken as 300KWh per month at R1.00 per KWh for the first year, with two 25% increases and a 10% yearly increase thereafter. It can clearly be seen that a SWH is the better investment over ten years and as the SHW subsidy stands at the moment, the initial capital investment in a SWH should be substantially lower than R30 000. The initial capital cost of the SWH is not shown in this graph. If it is shown, the investment in the SWH will overtake the cash investment from day one. As the SWH could realistically be resold at any point during the investment period, at least some of the investment value should be taken into account. For a more detailed discussion on this see Appendix 4.

Figure 14: Investment value: 6% yearly growth on a R30 000 investment vs. electricity saving of 300KWh per month



At present, it is financially beneficial for most consumers to have a SWH installed instead of a standard electric water heater.

The financial barriers to the installation of a SWH instead of an electric water heater at the point of water heater failure from the individual's point of view are not as high as they seem at first. The only financial barrier is access to the capital outlay. As was seen above, a SWH will be the cheaper option in the long run. Homeowners need to be informed about the financial benefit of SWHs so that it is seen for the better financial choice that it is. It is unlikely that this education can

happen at the point of water heater failure when the policyholder is in a panic and their main focus is on restoring things to the way they were. This education needs to take place before the failure happens so that the decision is already made in the mind of the policyholder and they are willing to pay a bit more upfront or get financing in place for the SWH and maybe wait a few days longer for the installation. If the decision is made before, the inconvenience will seem low as compared to the benefit. It is all a matter of perspective.

3.3 Financial options for the insurance company

The highest percentage of all types of claims (up to 70%) on building insurance policies in the residential market is due to failed water heaters (Addison 2010, de Ridder 2010a).

When a water heater bursts, there is often resultant damage to ceilings, walls and carpets and sometimes even furniture. The average cost for resultant damage claimed differs between insurance companies, but could be as high as 50% of the total claim on the homeowners policy. Resultant damage to furniture would not be claimed from the building insurance, but from the household policy and are in addition to this. The homeowners and household insurance is sometimes held at separate companies.

If a SWH is installed on a rooftop and the storage tank should burst, resultant damage is highly unlikely. This could mean a saving to the insurance company for the equivalent of the cost of the average resultant damage in the case of a claim for a SWH.

The average insurance payout for a failed water heater is between R5 200 and R5 700. The average resultant damage payout is between R3 500 and R5 200 (de Ridder 2010a, Harkema 2010a). In addition to these direct costs, there are additional administrative costs involved per claim, not least of which is the call-centre cost. It will benefit the insurer if a SWH is installed on the rooftop at an average cost of between R8 700 and R10 900 (the total cost of the average claim – the water heater plus the resultant damage). The total risk to the insurer will then be R10 900 at most (the cost of the SWH), but the risk of the collector panels and the storage unit all failing at once is rather unlikely. If a maintenance claim is included in the sale of the SWH, it should definitely last longer than the average water heater which is not maintained. SWHs are often sold with a maintenance plan and the sacrificial anodes are replaced every three years to protect the inside of the water tank from rust. A sacrificial anode is put in a standard water heater or the tank of a SWH if it is made from metal (some SWHs have fibreglass tanks). It is put there to be dissolved to protect the metal tank from corrosion. The sacrificial anode is made from a more active metal and is more easily oxidised than the metal it protects and will thus corrode first. In this

way, it acts as a barrier against corrosion. These sacrificial anodes have a life span of about three years, depending on the water quality. At present, water heater owners should replace the sacrificial anodes in their standard water heaters from time to time. This is, however, not often done. The insurance industry have taken it upon themselves to insure these units notwithstanding this neglect as it is considered unfair to expect policyholders to carry out inspections of their water heaters (de Ridder 2010a). It might be time to change this culture for the better as the exclusion of water heaters (or SWHs) with fully corroded sacrificial anodes will reduce water heater claims significantly. The change to a SWH is a brilliant opportunity for the insurance industry to change the culture of responsibility for the maintenance of the water heating unit. If policyholders take responsibility for the maintenance and replacement of the sacrificial anode as well as checking of the fluid in indirect units, then the claim incidence of failed units should reduce significantly.

The administrative cost, per claim when a SWH is installed in place of a failed water heater, will go up in the short-term as new systems need to be put in place and employees need to be trained. It might also be envisioned that this administrative cost could stay marginally higher on a claim where a SWH is installed than when a standard water heater is installed, due to the installation being more complex and different for every home.

If a SWH is installed inside the roof, the risk of resultant damage should stay the same but the price of the unit is more than the standard water heater. It is thus to the benefit of the insurer to install a SWH on the roof outside the house.

If a SWH is installed inside the roof, it will most probably be installed in the same place as the original water heater and the roof structure should be strong enough to hold the extra weight. The storage tank of an installed SWH is often bigger than the water heater it replaces. A water heater can produce hot water on demand, but a SWH should get maximum heat from the sun. As the sun only shines in daytime, a bigger storage unit is needed for the same amount of hot water usage. If the SWH is installed outside on the roof, there is a slight risk to the insurer that the storage unit might be too heavy for the roof structure. It is unlikely, though that this risk will have to be carried by the insurer. The building code relating to the installation of SWH specifically states that, before installation, an assessment of the roof structure that will support the solar collector shall be carried out by a competent person, in accordance with the requirements of the South African national standard for building regulations, SANS 10400 (SABS 2010) Most roofs in South Africa are designed to carry a dead weight of fifty kilograms per square metre and its related (i.e. wind and rain) and anticipated loads. SWHs are usually installed on the rooftop straddling two or more roof beams and most roofs should be strong enough to hold this weight. If, however a SWH which was

installed by an insurance company should break a roof, this would most likely be rectified by that insurer for reputation-saving purposes.

If an insurer starts to install a SWH on behalf of a policyholder during the indemnification process and encounters unexpected difficulties, then the risk falls on the insurer in terms of the insurance law. The insurer has a legal obligation that once they elect to repair, they will repair until the repairwork is complete. In the case of a SWH installed on a rooftop, unintended damage might occur to the roof tiles while working on the roof. These roof tiles might not be available on the open market anymore and it might fall onto the insurer to replace the entire roof (asbestos roof cladding is a good example) (Genis 2010a). As more SWHs are installed on rooftops, the installers will become more skilled and the likelihood of damages to property will diminish.

It is unlikely that any insurer in South Africa will decide to finance SWH installations in the place of failed water heaters at their own cost. As this would constitute replacing an item with one that is higher priced, it is in possibly illegal. This is, however not necessary as the policy owner will benefit from the electricity saving due to the installation of a SWH and should be willing to pay for it. It is, to the benefit of the insurer to convince the policyholder to switch to a SWH on the roof at his own cost.

It is unlikely that an insurer will benefit from the policyholder's loyalty if a SWH is installed. A policyholder could change insurer at a whim (Harkema 2010).

The monthly premium for homeowners insurance is typically quite low in comparison to other insurance (car and household). It is thus also unlikely that a policyholder will choose an insurer on price or discount offered on the policy premium alone, unless this discount is substantial. It is unlikely that an insurer will decide to increase the premium due to a SWH on the roof as this will be very bad marketing and put them at risk of losing clients (de Ridder 2010a).

A policyholder is hardly ever asked about the number or type of water heaters in the house when a policy is taken out. Some insurers are under the impression that there is a higher risk to them due to the solar collector on the roof (de Ridder 2010a). A SWH on the roof is considered to be in greater danger of being damaged in a severe storm. When a SWH has approval from the South African Bureau of Standards (SABS), it would have been vigorously tested to withstand even a severe hailstorm (Deist 2010). The value of a SWH in comparison to the value of a roof and roof structure is low and in the event of a severe storm where a SWH or collector gets damaged, the roof would in addition also be damaged.

If an insurer decides to become carbon neutral and is looking for carbon offset opportunities, it will be very effective as a marketing initiative to reduce the electricity consumption of its own policyholders by installing a SWH in the place of a failed water heater. This could be a much better marketing opportunity than buying carbon offsets through a third party. In this instance, a policyholder can be paid out for the carbon credit as a discount on the installation of the SWH at an agreed price per type of SWH. The carbon credit could, however also be used to finance the maintenance of the SWH. Paying for the maintenance in this way will save the client money as well as reducing the risk to the insurer as the sacrificial anode will be replaced and the solar collectors serviced.

Alternatively, if the insurance companies are not interested in their own carbon emissions, they can register their SWH installations as a programmatic CDM and sell the carbon savings off to another company. The carbon offset market is quite unstable at the moment and it is difficult to put a price on the carbon that will be saved per SWH (Abel 2010). This would have to be negotiated per programme.

Players in the insurance industry are risk managers and the risk of damages to property will most probably increase with climate change and resultant increase in extreme weather conditions. This is, however, a long-term risk and difficult to quantify and juxtapose against the benefit of short-term reduction of carbon emissions due to actions now. It is extremely difficult to quantify this in financial terms against the cost of a SWH.

An alternative to a full SWH programme in the replacement of failed water heater is to have “solar enabled” water heaters installed in policyholder’s homes. This would entail replacing a standard electric water heater with a water heater which can be easily powered by a solar collector panel to be installed at a later stage. The insurance company might be able to gain from this in terms of marketing but, as the new water heater will be installed at the same place as the failed one which is usually in the ceiling or inside the house, they will not gain from future reduced claims on resultant damage. A “solar enabled” water heater will also have a lower wattage element and will heat the water slower than the replaced water heater. A SWH for the replacement of an existing water heater is usually bigger than the replaced one. If this is not done, a lower solar fraction will be experienced once the solar panel is installed. (Less power from the sun equates to more from the electrical back-up element). If a solar panel is not installed, the larger storage area from this water heater will use more electricity to heat up the water.

An attempt was made below to quantify and compare the risk for the insurance company of insuring a SWH versus a standard electric water heater.

In example A, the SWH price is taken as three times the price of the water heater. The resultant damage is taken as 65% of the price of the water heater. (In some companies this is as high as 100%.)

The other costs were then taken as 17% of the cost of the water heater for a standard electric water heater and slightly higher at 20% of the cost of an electric water heater for a SWH. The additional costs might be higher in the short-term but, when the systems are in place and the SWHs become the default installation, these costs will come down.

The claim frequency of a standard water heater was taken as 5.7 years and the claim frequency of a SWH was taken in Example A as 10 years and in Example B as 15 years. It would be to the benefit of an insurer to install good quality units and make sure that these units are well maintained with a contracted maintenance plan.

The results show that installation of SWHs will either cost the insurance company the same, or save money due to the higher quality of the SWH systems and the eradication of resultant damage.

Table 9: Comparison of risk for insurance company, standard electric water heater vs. SWH

Example A:

	Electric	SWH
Cost of the unit	100*x*	300*x*
Resultant damage	65*x*	0
Other costs	17*x*	20*x*
Total	182*x*	320*x*
Claim frequency (years)	5.7	10
Per month	2.66*x*	2.66*x*

Example B:

	Electric	SWH
Cost of the unit	100*x*	300*x*
Resultant damage	65*x*	0
Other costs	17*x*	20*x*
Total	182*x*	320*x*
Claim frequency (years)	5.7	15
Per month	2.66*x*	1.78*x*

The promotion of SWH to policyholders is in the interest of the insurance industry, just like all carbon reduction mechanisms are. It is not expected that the insurance industry should foot the bill for the change. This could be done by the policyholder, with help from the government in the form of a subsidy as it stands now, or another similar financial mechanism. The insurer should, however, in its own interest and in the interest of the bigger picture, actively encourage the change to SWH and put mechanisms in place for the easier change over in the event of a failed water heater.

A SWH programme operated from within an insurance company will most probably cost the company money in the short-term. This should be seen as money well spent. It should be financially beneficial for an insurance company in the long-term to persuade their policyholders to change to SWHs.

3.4 Triple Bottom Line

Holm (2005) pointed out that some of the barriers to the penetration of SWHs into the South African market are the omission of externality (social and environmental) costs as well as the omission of price volatility costs of conventional energy. In addition he pointed out that the insurance industry practices also prove to be a barrier.

Companies are no longer only measured on financial success. Environmental and social issues are becoming more important, as argued in Chapter 2.3.

All companies have an impact on the environment and the financial sector, of which the insurance industry is a part, is no exception. There are many ways in which an insurance company can reduce its impact on the environment. Some examples are reduced travelling for business purposes by using tele-conferencing, and reduced paper use by sending out bills electronically or recycling paper that is used in offices. Insurance firms can also take responsibility for the supply lines and ways of disposal of the companies responsible for settling the claims of policyholders. In this way some insurance companies have already embarked on schemes to ensure the least environmentally harmful way of disposing of discarded parts associated with motor vehicle claims (Sedres 2010).

Putting a SWH programme in place within an insurance company should not only be seen as a great opportunity to reduce the company's negative impact on the environment but also as their social responsibility. As the insurance industry is responsible for more than 50% of all water heater

installations in South Africa, they should take responsibility for these installations and put programmes in place to convince their policyholders to change to a SWH at the point of water heater failure.

The insurance industry spends vast amounts of money annually on marketing and sponsorship. Some insurance companies have long infomercials broadcast on television and on radio. Many of these infomercials relay information already well known to the general population and merely serve to remind consumers of the company. These promotional advertisements could be used to promote the company's environmental profile. A SWH programme could form a strong part of this. In this way a SWH programme could form part of a big marketing campaign for the company while at the same time promoting the installations of SWH in general.

Two insurance companies have already embarked on SWH programmes and most other big insurance companies are investigating possibilities in this regard. If these programmes really start to become successful, this could be used as a strong marketing tool for the companies involved. In addition, it will reflect negatively on those companies who do not have programmes in place.

The short-term cost of the introduction of a SWH programme by an insurance company will most probably be outweighed by the long-term gains.

3.5 Chapter Summary

The South African water heater industry is in a lock-in situation where the entire system is geared towards providing standard electric water heaters to homeowners. Because the insurance industry manages 50% of this market due to the replacement of failed water heaters, they occupy a significant role in this system.

At current SWH prices, it is financially beneficial for most homeowners to invest in a SWH. The high upfront cost is offset by the rising electricity saving. If the change to a SWH happens at point of water heater failure and the homeowner has comprehensive homeowners insurance, the insurance payout could be used as a deposit on a new SWH and this makes the installation of a SWH even more financially beneficial.

If a SWH is installed on a rooftop, the likelihood of resultant damage, should the SWH fail, is negligent. Because up to 50% of water heater claims are payouts for resultant damage (excluding damage to furniture which is covered by household insurance), this risk will be dramatically reduced. It should thus be financially beneficial for an insurer if a policyholders has a SWH on his/her roof instead of a standard electric water heater inside the roof.

Because insurance companies are risk managers and, as such, will suffer financial losses due to changes in risk profiles associated with climate change induced events, they have a financial interest in mitigating climate change. One very effective way to do this is to encourage their policyholders to change to a SWH.

Chapter Four: Case Studies

4.1 Introduction

There are four major banks in South Africa. These are Nedbank, Standard Bank, Absa Bank and First National Bank. All four of these banks have their own insurance divisions. The homeowners' insurance forms a major part of their business. When a homeowner purchases a new home and a homeloan is taken out, they often automatically acquire homeowners insurance through the insurance arm of the bank where the loan is made. The homeowners are free to go to the insurance firm of their choice but it is often the easiest and most convenient to use the insurance arm of the relevant bank. The fact that many homes in South Africa are bought through homeloans through these four banks resulted in these insurance divisions becoming major players in the homeowners' insurance market. This coalition bodes well for a SWH programme as the pay-in difference in the case of a failed water heater being replaced by a SWH can be financed by the banking arm of the insurer.

In addition to these insurance divisions of the banks, there are quite a few insurance companies in South Africa which are not affiliated to banks. Interviews were conducted with key players from two such insurance companies, Hollard Insurance and Santam Insurance. These insurance companies do not have the advantage of having a banking arm which could finance the SWH cost difference. They are, according to the National Credit Act, not allowed to finance the difference themselves as they are not registered credit providers. They could, however, form strategic alliances with banks so that they could offer an "all-in-one" solution to their policyholders.

Most insurance companies in South Africa allow a policyholder to change to a SWH at the point of water heater failure at their own expense and if it is administered by themselves. Only two major insurance companies have official SWH programmes running to replace a failed water heater with a SWH. Santam rolled out a country wide programme in February 2010 and Absa started with a pilot programme in Cape Town in June 2010.

The SWH industry in South Africa is in its infancy. Significantly less than 10% of all hot water solutions sold in South Africa are SWHs. Since this is the case, one should not be surprised that the amount of knowledge and interest in SWHs in the business and particularly the insurance and financial sector is very low. This is, however changing and this researcher noticed a rapid growth in interest in SWHs during the study period.

Because water heater claims make up about 50% of all claims on building insurance in the residential sector (Addison 2010), sophisticated systems have been put in place over the years to

streamline the claim process. If an accident related claim is lodged for car insurance, often an assessor first has to assess the damage before the claim will be settled. This used to be the case with failed water heaters too. With time this process changed, because the financial loss due to fraudulent claims through plumbers is considered to be less than the damage to the image of the insurance company if they make it difficult to claim a water heater. As the building insurance often makes up a small percentage of the overall insurance that a policyholder has, the fraudulent claims is a small price to pay for more customer loyalty. Due to these facts, an opportunity arose for Incident Managers to administer plumbing related claims on behalf of insurers. One such incident management agency, which operates countrywide and procures and installs about 50 000 water heaters annually on behalf of various insurance companies (including Santam, Hollard, Standard Bank, Nedbank and Absa), is Fogi (Middleton 2006). Because these Incident Managers focus on plumbing claims exclusively, not only is the turnaround time for the claims reduced but the incidence of fraudulent claims is reduced too. Fogi's representative reports that they reduce the claim incidence by about 25% due to their systems. Since these firms' call-centres deal with plumbing claims exclusively, the call-centre operators should be much better trained to deal with specifics and, through this system, it would then also be much easier to train call-centre operators to promote the change to SWH.

4.2 Hollard

Hollard is South Africa's largest independent and privately owned insurance group and has both short-term and life insurance licences. Hollard prides itself in being a company with an impressive track record of innovation in distribution and product development (Hollard 2010).

The first interview conducted with the insurance sector by this researcher was with Hollard Insurance. Adi Enthoven, an executive director of Capricorn Ventures International, the main shareholder of Hollard insurance, was and is very committed to environmental concerns. The Hollard family are in addition involved with the Spier Estate in Stellenbosch, which is a wine farm, hotel and conference facility known for their environmental concerns. Adi Enthoven contacted the researcher via the Sustainability Institute aiming to gain knowledge and understanding to develop a SWH programme within Hollard. The shareholder company has influence but very little say over the day-to-day business decisions made within Hollard.

Interviews and extensive e-mail correspondence was conducted both with Adi Enthoven and employees of Capricorn Ventures International and employees within Hollard Insurance.

The homeowners component of Hollard's insurance portfolio is very small and they only directly hold about 13 000 homeowners policies. Hollard had 2 368 water heater related claims for the period 1 February 2007 to 31 January 2009. This comes to about 1 200 water heater related claims per year. They do not keep records of the amount of actual water heaters replaced (some claims might only involve a replacement of part of a water heater); neither do they split their records of claims for damage to the water heater itself versus resultant damage. The average claim per incident is R5 478 (Harkema 2010a). There are no records kept of the amount of water heaters per household (or per policy), so claim statistics per water heater insured are not available. There are in addition another 14 240 building policies held at the Bank and Motor Division (BMD) and another 12 730 policies held at Hollard Select Brokers (HSB) (Harkema 2010b). These are also Hollard policies, but are administered by outside companies and thus do not fall under direct control of Hollard. Hollard might, however have influence over the claims procedures within these policies. The homeowners insurance policies held by Hollard Insurance, both within the company itself and through outside brokers, make up about 10% of total policies held (Harkema 2010b).

The employees of Hollard Insurance were very willing to speak both directly and via e-mail to the researcher and in addition also willing to share statistics where this was available. As in all other corporate environments encountered during the investigation, the level of knowledge of SWHs were found to be quite low. Even though the level of interest was found to be reasonably high from the investment company's side, the level of interest within Hollard for a SWH programme was found to be low. It was also found that there is an opinion from the business side that because the building insurance part of Hollard is very low in comparison to their other business, it will be wiser to invest their time in other programmes thought to be environmentally friendly or carbon reducing within other parts of the business. A counter argument to this could be that, seeing as the homeowners part of the business is so small, it is an easy section to involve in a new programme as the risk is so much lower.

A high level investigation into a SWH programme was launched at the level of the shareholders in May 2010, with some employees spending exclusive time on this investigation. Even though the level of interest toward such a programme was still evident, the outcome was a "wait and see" approach and the plans for a SHW programme were put on hold in July 2010 (Bozonne & Goldin 2010). In September 2010 this researcher was yet again contacted by employees from Capricorn Venture Investments. They are putting together a fact base detailing information needed for the roll out of a SWH programme within Hollard. They are hoping to move forward within the SWH space within the not too distant future (Bozonne 2010).

4.3 Santam

Santam is South Africa's leading short-term insurance company with market share nearing 23% and has more than 650 000 policyholders on its books. 95% of Santam's business is done through brokers (Santam 2010a). Santam procure and install approximately 40 000 standard electric water heaters per year in the homes of their policyholders as the replacements of failed water heaters (Asmal 2009).

Santam is 8th on the list for carbon disclosure as rated by the NBI for 2009 and the second financial company on the list (after the Nedbank Group). This company was also one of only three financial companies to make the top 16 companies as rated by their actual emissions for 2009.

Santam hosted a conference on climate change in September 2009. This conference formed part of Santam's commitment to addressing the enormous challenges of unsustainable practices on which most of the industry is built. Santam has identified the insurance sector as being one of the businesses which will bear the worst consequences of climate change and this conference was a demonstration of its commitment to understanding and evolving its own business in response to what it accepts as a very real challenge. Santam is in addition measuring its own carbon footprint and was already seeking to implement measures to manage it (Santam 2010b). Since then, some measures have been implemented to reduce the carbon footprint. Most notably is the procurement and disposal chains within the motor vehicle claims division and some projects to help staff members in their own carbon footprint reductions (Sedres 2010).

Santam was also the first insurance company in South Africa to embark on an official SWH programme. A pilot programme was launched in partnership with the Department of Public Enterprises (DPE), Eskom and Unlimited Energy in September 2009 (Asmal 2009) and a national programme was rolled out in February 2010 (Creamer 2010a).

It was a struggle at first for this researcher to obtain interviews with key players within the Santam SWH programme. Only after a Sustainability Forum meeting (organised by the South African Insurance Association (SAIA)) was attended in Johannesburg, and key players were met face to face, was it possible to make important contacts. Once a relationship was established, the amount of support, sharing of knowledge and time of key players in the Santam SWH programme was more than expected.

For logistical reasons, Santam's SWH programme is only available from claims lodged at the central call-centre at the moment. All operators at this call-centre have been given extensive

training to offer this option to every policyholder reporting water heater failure, as part of the indemnification process. The direct financial operating cost of the SWH programme to Santam is estimated to be high. They are not calculating this financial cost as they are committed to the programme notwithstanding the high cost (Genis 2010b). Even though Santam has spent a lot of time, effort and money on their SWH programme, the uptake has been much less than expected.

When a policyholder lodges a claim at the central call-centre, the option of changing to a SWH is offered. Santam will administer and finance the Eskom subsidy on behalf of the policyholder and also gives a discount for future carbon savings of around R1 500. Santam is not prescriptive as to the system installed, but the policyholder is encouraged to install a good quality system, which is "like for like". However, only Eskom- and SABS-approved SWHs are on offer. Because a solar collector can only produce hot water when the sun is shining, a bigger storage tank than that of the failed water heater is usually required for the policyholder to have the maximum benefit from solar energy.

According to Gerhard Genis, Head of Quality Management at Santam, and one of the main advocates of the SWH programme, the uptake has been "approaching zero" (Genis 2010b). The main reason given by Santam for this low uptake is the financial contribution by the client. Policyholders are not considered to have enough money or access to finance to afford the SWH.

Four recordings of water heater claims lodged in the week of 12 July 2010 were accessed from Santam and the following observations made:

Three of the four claims were called in by the policyholder's insurance broker. In the one case where the call was made by the policyholder himself, there was no interest in the installation of a SWH.

When a water heater related claim is lodged, all the relevant contact and policy numbers are first taken down. The question is then asked as to whether a plumber has already been to the premises and after that the SWH option is offered. The question is posed in the following way: Would you (or do you know if the client would) like to opt for the solar water heater or the standard electrical water heater? In three of the four calls listened to, the offer was summarily rejected and the option for a standard electric water heater was adopted without further questions.

In the case where there was further investigation into the offer, the broker calling in had obviously never heard of the offer before. She called the policyholder with the offer while the call-centre operator was holding on and the policyholder was interested. The details were taken down. After

follow-up investigation from this researcher, it was established that a SWH was not installed, as the water heater was merely fixed and not replaced.

It is important to note that the call where there was interest shown in the SWH took twice as long as the second longest call and four times as long as the shortest call. Because 'time is money' in the case of the call operator, this factor needs to be taken into consideration. The time factor could be shortened as the brokers and policyholders come to learn about the programme but will probably always take a bit longer than a call for the replacement of a standard electric water heater. The time factor might in addition play a part in the reason for brokers summarily turning down the offer of replacement by a SWH, as their time also costs them money and they might not be inclined to relay the information about the offer or even the offer itself. This factor could be strengthened by the fact that in the cases where it is offered, time is spent on the offer and in the end the policyholder might opt for the standard electric water heater anyway. This will reinforce the idea with the broker that policyholders are not interested in SWH. As general awareness of SWHs grows, many more SWHs might be demanded by the policyholder at point of water heater failure and this programme might work notwithstanding its perceived failure at present. The Santam SWH programme in itself will further increase awareness of SWHs in general in the country.

Santam did an internal investigation into the operation of the SWH programme for the week of 12 July 2010 to specifically determine why policyholders are not opting for SWH and to investigate whether the opportunity is being relayed optimally by the call-centre operator at first notice of loss (FNOL). The following challenges were noted by Santam:

- The client accepted the SWH replacement, but no service provider was able to assist in the area at the time;
- Santam was forced to reimburse clients as they had insisted on replacing with SWHs and made use of their own service providers to do so;
- Most telephonic claims are registered by brokers who seldom want to hear about Santam's SWH option and request a standard electric water heater replacement without liaising with the client first;
- The client accepted the SWH option, but the service provider confirmed that the water heater was still under warranty and referred the claim back to Kwikot. (In this instance, Santam was still liable for the call out fee to the service provider);
- The clients as well as brokers are seldom aware of the advantages of SWH and therefore do not opt for it even after the call-centre agent offers the option;

- Should the policyholder have resultant water damages and / or are in a hurry to replace the water heater, he / she only wants the simplest way out and requests a standard electric water heater and not a SWH (Sharbodien 2010).

As all successful SWH installations by Santam are handled through a different department, these could not be tracked and were thus not investigated in this instance.

The researcher found it interesting that some policyholders decided to opt for a SWH provider outside of the Santam programme. This could be for various reasons and reasons noted will be of a merely speculative nature. Reasons for this decision could be because of opting for a cheaper (and maybe not optimal) SWH or it might be that the policyholder does not yet trust the insurance firm to make the right choice on their behalf. It might also be that the policyholder had already investigated the possibility of a SWH prior to the failure of the electric water heater and were already far in negotiations with a specific provider. In such a case, the failure of the water heater which was going to be replaced in any case could be seen as an added bonus, an extra discount on the new SWH.

It was noted by this researcher that Santam has many very capable and motivated employees at all levels working on the SWH programme who all want the programme to work. It was, however also noted that very few of these employees of Santam have a SWH on their own roof. It is possible that the programme might be more successful by running a staff programme for mass installations of SWHs, so that the intricacies and day-to-day operation of a SWH could be better understood both in the use of energy and the monetary savings to be had.

Even though the uptake of SWHs through the Santam programme has been sluggish, valuable lessons can be learnt from it. Santam has stuck its neck out and has been (by almost a year) the first insurance company to offer an official programme to replace a failed water heater with a SWH.

4.4 Absa

Absa Group Ltd is one of South Africa's leading financial institutions. Absa Group Ltd is the 100% shareholder of Absa Financial Services, under which Absa Insurance Company, the group's short-term insurance division, falls (Absa 2010).

Absa did not make it into the top 16 companies rated for the disclosure of their carbon emissions by the NBI for 2009.

Absa Insurance has more than 500 000 homeowners policies on their books and procure and install about 30 000 standard electric water heaters per year in the place of failed water heaters (de Ridder 2010a). All plumbing related claims within Absa insurance is handled by Fogi, an external incident management agency.

Absa Insurance is in a unique position of being able to offer a comprehensive all in one package of a replacement SWH for a failed water heater, insurance on said new SWH, as well as financing of the shortfall.

In addition to water heater replacements as they fail, Absa Insurance and Absa Bank could also run a programme where water heaters are pro-actively marketed through the bank and procured and installed via the mechanisms already in place through the insurance arm. In this way a potential 500 000 SWH could be installed in homes across South Africa if the installations are taken at one SWH per home. Many of Absa clients, however, have more than one electric water heater installed in their homes at present (de Ridder 2010a).

In July 2010 Absa Insurance embarked on a SWH pilot programme. This programme is run in Cape Town only. Selected policyholders who have lodged a water heater claim are phoned and a SWH is offered in place of the standard water heater. The difference in value between the failed water heater and the SWH is payable by the policyholder with the take up of this offer. This amount will differ depending on the existing water heater and the type of SWH chosen. Only policyholders with more than one water heater in the home are selected for this offer. If there are two or more water heaters in the home, the policyholder will not be as inconvenienced by the longer waiting period for the installation of the SWH.

In the period of 14 June 2010 to 20 August 2010, 156 calls were made to Absa Insurance policyholders who had lodged water heater claims. Of these calls made, two policyholders (1.3%) took up the offer to change to a SWH through this programme. It is interesting to note that six (3.9%) of the policyholders called in this period decided to change to a SWH, but through a different company. For 42% (66) of these policyholders called, the financial difference (shortfall) between the standard electric water heater and the SWH offered by Absa Insurance was considered too high and the offer was turned down because of this. Two of these policyholders for whom the price difference was the problem also mentioned the longer waiting period as a reason to turn it down. One of these policyholders had an additional problem due to his house not being suitable for solar technology. In about 15% of the calls made, the standard electric water heater had already been replaced. Just over 8% of policyholders called had no interest in the SWH whatsoever (de Ridder 2010b). For an analysis of the calls made see Table 10 below. The details of all calls made, are available in Appendix 6.

Table 10: Analysis of calls, Absa SWH pilot programme 14 June to 20 August 2010

SWH installed by ABSA	2	1.28%
SWH different company	6	3.85%
Replacing existing SWH	2	1.28%
Interested, but decides against - no reason given	5	3.21%
Shortfall too high	66	42.31%
Water heater already replaced	23	14.74%
No interest	13	8.33%
Under guarantee / warrantee	9	5.77%
Can't wait that long	6	3.85%
Does not live in house	5	3.21%
Water heater doesn't need replacing	3	1.92%
Roof / house / area not suitable	3	1.92%
Area disallows SWH	2	1.28%
House in process of being sold	3	1.92%
Lives by himself, so minimal saving	2	1.28%
Could not get hold of client or wrong information	4	2.56%
Water heater has timer, so already saving	1	0.64%
Needs more info	1	0.64%
Total calls	156	100.00%

Source: de Ridder 2010b

Miguel Martins from Absa Group Corporate Affairs and Sustainability has recently installed a SWH on his house. His own water heater failed and he installed the SWH via his insurance claim. His insurance is held by Absa Insurance. He took the payout from his failed water heater and financed the rest of the SWH price and installation himself (Martins 2010). No employees interviewed from Absa Insurance, working on the SWH pilot programme, have SWH installed on their own homes.

This was also noted by Holm (2005) in relation to officials working on SWH programmes. One employee is, however, in the process of building a new home and the installation of a SWH is required by the developer (de Ridder 2010a, Craven-Sutton 2010).

4.5 Nedbank

Nedbank is one of South Africa's leading financial institutions and is most known for its environmental mindfulness. They were the first financial institution in South Africa to claim to be carbon neutral (van der Merwe 2010c). Their new premises in Sandton was the first building in South Africa to gain green star accreditation from the Green Building Council of South Africa (GBCSA) in 2009 (Swanepoel 2009). In addition, Nedbank is the first company on the list for the CDP of the NBI for 2009 and also made it to the list of the top 16 companies in South Africa as rated by their actual emissions in a pilot project.

No strong contacts within Nedbank were made by the researcher during the year and none of their employees were willing to share any significant knowledge. A meeting was held with an environmental consultant from Nedbank and it was understood that both their insurance division and the bank itself are looking at different SWH options for the future (Louw 2010). A web-query sent to Nedbank about water heater insurance and SWH was forwarded to Giovanni Aquisto from Fogi for reply (Aquisto 2010). Fogi handles all plumbing-related claims on behalf of Nedbank. The follow up on this query did not result in any more knowledge gained.

4.6 Standard Bank

Standard Bank is another one of South Africa's four major banking groups. Standard Bank and its insurance division, Standard Bank Insurance Services, are looking into ways to get involved in the renewable and alternative energy field. They do not, however have any fixed plans for any SWH projects at present (Kuhn, 2010).

4.7 First National Bank

First National Bank is yet another one of South Africa's four major banks. This bank is part of the First Rand Group. The major insurance company within this group is Outsurance. First National Bank are investigating possibilities around energy efficiency, renewable energy and alternative energy, but do not have any SWH programmes running at present (Botha 2010).

4.8 Fogi

As water heater and other plumbing related claims make up such a high percentage of claims on homeowners policies in South Africa, an opportunity arose for the introduction of Incident Managers who could specialise in handling these claims. These Incident Managers are able to handle the claims more efficiently and at a lower cost than the insurance companies are able to do in-house.

One such Incident Manager is Fogi, an agency that administers the replacement of about 48 000 water heaters per year for various insurers (Aquisto 2010b). Such Incident Managers are clearly key points of change if water heaters are to be replaced via the insurers. These Incident Managers have systems in place which compare the incidence of replacements of different plumbers against each other and deviant spending will be picked up.

In addition it is claimed that through their systems, the amount of claims are brought down by about 25%. Fogi handle all plumbing related claims for Absa Insurance and Nedbank Insurance. The Absa SWH pilot programme is administered through Fogi (Aquisto 2010a). In addition Santam uses their systems for some of their plumbing related claims.

Giovanni Aquisto from Fogi has noticed an increase in the number of policyholders demanding a SWH in the event of a water heater failure. This number is, however still very low and not even 1% of water heaters installed (Aquisto 2010a). It was in addition anecdotally noted that the SWHs that were installed by Fogi had significantly more comebacks. Most of these queries where for minor problems, such as the noise which the SWH pumps make.

It is interesting to note that Giovanni Acquisto from Fogi has had a SWH on his own home for 15 years.

4.9 Chapter Summary

There is much interest in SWH programmes within the insurance industry in South Africa and most insurance companies are investigating opportunities in this regard.

However, only two insurance companies in South Africa have SWH programmes running. Santam rolled out a nationwide programme in February 2010 and Absa started with a pilot project in the Cape Town area in June 2010.

At both these companies, the SWH programme forms a small part of the overall responsibility of the employees involved. The take up rate, in both programmes that are running, is extremely low.

The biggest reason given for the low uptake is that the cost difference between a standard electric water heater and a SWH is too high, even if the Eskom subsidy, a discount for carbon credits and the replacement cost of the failed water heater are subtracted.

It was noted that very few of the key players or other employees working on SWH programmes within the insurance and banking industry have a SWH at their own homes. This was also pointed out by Holm (2005) in relation to officials working on SWH programmes.

Although the biggest obstacle to the uptake of SWHs at the point of water heater failure is seen as the cost factor, this is a misconception that is reinforced by the institutional logic, interests and values embedded within the existing system. If the case studies considered in this chapter are seen in the light of the literature discussed in Chapter 2.6, it becomes clear that that the system is in a lock-in situation. It is geared towards supplying standard electric water heaters to policyholders when their water heaters fail. The citation of the cost factor is merely an emergent symptom of the existing dynamically stable system. The specific challenges that need to be faced to mainstream SWHs in this country, and the role of the insurance industry, needs to be seen from a socio-technical lock-in perspective to be fully understood.

Chapter Five: Interpretation of research

5.1 Introduction

The South African government has recognised the important role that solar energy, and particularly SWHs, can play in both the reduction of GHG emissions and solutions to the energy supply crisis that it faces. Policies are in place and are being put in place to promote the installations of SWHs. However, as the SWH industry in South Africa is still in its infancy, it would be wise for the policymakers to now put the focus on research and development, as well as marketing and awareness campaigns, for the South African market to mature and flourish. Next to the high capital cost of a SWH, the lack of awareness has been noted as one of the major obstacles for the uptake of SWH (Holm 2005).

In this chapter, the research is interpreted. Discussion focuses initially on the barriers to the roll-out of SWH technology, followed by the opportunities which exist in the market.

The situation is further described in terms of system dynamics and graphically represented by means of a causal loop diagram to point out some of the positive and negative feedback loops which exist within this complex system.

5.2 Barriers to the roll out of SWH via the insurance industry

The dominant view in both the SWH industry and the financial and insurance sector is that the low uptake of SWH in South Africa is due to the high upfront cost of installation. In the specific case of an insurance claim for replacement of a failed water heater, the longer waiting period for installation is sometimes given as an additional reason.

Some other issues mentioned for the slow uptake are: the Eskom subsidy that is not trusted (anecdotally, everyone knows someone who didn't get their subsidy), the technology that is not trusted or understood, doubt about the veracity of claims that future electricity savings will be made, and bewilderment at the many choices to be made in the selection of of SWH units as well as SWH companies. When a standard electric water heater is installed, the homeowner does not feel the responsibility of the choice. They hand that choice over to the builder or the plumber, with very little input from themselves (or the insurance industry in the case of a failed unit). This entire system has been geared to supply a specific product in a specific way at a specific price.

This is symptomatic of a dynamically stable system where lock in has occurred (described in Chapter 2.6 in the discussion of socio-technical systems).

However, if installation of a SWH is requested, the responsibility of the choice is handed over to the policyholder. It might be the case that the policyholder is keen to change to a SWH on a theoretic level but, when confronted with the choices, decides to stay with what they know, have always had and trust. The SWH industry in South Africa is still in a niche phase and as such can only operate in niche markets.

One solution might be to relieve the policyholder of the choices involved in the installation of a SWH away and leave these to the insurance company on the basis that it offers a good quality product installed by a competent installer. This would serve to instil trust in the consumer market for the technology. It would require regulation, to enforce the installations of SWHs, or a bold stand from the insurance companies to promote SWHs. The risk associated with this approach is that, if poorly performing units at uncompetitive prices are chosen by the insurers, it could diminish the market's trust in SWH technology. The challenges to the policyholders, insurance companies and the country as a whole is summarised in Table 11 below.

Table 11: Challenges to changing to a SWH at the point of water heater failure

Policyholder	Insurance Company	South Africa
A slightly longer wait to have hot water re-installed	Administrative burden of Eskom subsidy	If the technology is not used, it is a missed opportunity
A higher upfront cost	Administrative burden of carbon credit or CDM	Regulatory environment might be set in place to encourage change to SWH at this point
Confusion about which SWH to choose	Shared responsibility of choice of system	An aggressive marketing campaign is needed to make SWH the preferred and desirable option
Technology not trusted	Short-term risk of bad installations until the market grows and stabilises	
Aesthetics		

A change to a SWH at the point of water heater failure is not merely a matter of getting the finances right. If the policyholder does not trust the technology or simply finds it aesthetically unappealing, he will not make the change no matter what the savings might be. The SWHs that are most noticeable in the environment are the most unattractive ones, because they are the ones that do not blend into their surroundings. The SWHs that are better designed to blend into their environments are just not noticed. If SWH companies, the government and the insurance companies place too much emphasis on bringing down the price of the units, the quality of the systems might drop; the cost of installation might not increase, or it may increase for other reasons. International precedent has shown that the main obstacles to SWH penetration has been awareness and the high upfront cost (Holm 2005). The upfront cost in the South African context is quite low in comparison to the electricity that can be saved (see Appendix 5). In addition, the South African SWH prices compare well to prices in other countries (Milton *et al* 2005).

Modern consumers are used to taking delivery of a product immediately, without having to wait. A SWH will probably always take longer to install than a standard electric water heater due to (at least) the new piping needed on the panel on the roof and because the site needs to be investigated for optimal installation. Some anecdotal stories about water heaters and SWHs, told from a personal point of view, are included in Appendix 5.

5.3 Opportunities for the roll-out of SWH via the insurance industry

The point of water heater failure is a great opportunity to change to a SWH. It represents an opportunity on various levels for the policyholder, for the insurance company and for the country as a whole (see Table 12).

Table 12: Advantages of changing to a SWH at the point of water heater failure

Policyholder	Insurance Company	South Africa
Effectively gets a SWH at a discount of the value of the failed water heater	Could offset the emissions saved against own emissions	Reduction of peak load demand of electricity
The Eskom subsidy is administered and financed on their behalf.	Could be used for future carbon tax benefits	Reduce electricity base load demand
Extra discount for carbon credits or CDM	If the SWH is on the rooftop, resultant damage claims will disappear.	Reduces GHG emissions
Future electricity savings can be seen as a great income on investment	Could get a higher score in CDP, with resultant publicity	Assists in reaching the target of 10 000 GWh of electricity from renewables by 2013
A great time to make the move to a SWH as the replaced water heater is no longer able to be fixed.	Great feel-good marketing tool	Assists in reaching the target of one million SWHs by 2014

South Africa has a very low SWH market penetration in comparison to other countries even though it receives vast amounts of solar radiation annually. Historically, the price of electricity in South Africa was very low. This is changing. The example of Malta, however, shows that a high electricity price and high solar radiation alone will not necessarily set in motion a successful SWH industry. Awareness and marketing campaigns as well as consumer education are necessary to achieve this.

SWHs also present an opportunity to market a product through the medium of awareness campaigns. The responsibility for this could be shared between all parties concerned, the government, the SWH industry through the industry organisation (SESSA SWHD) and financial institutions offering loans for the capital cost. The insurance industry could also possibly help by sponsoring marketing or awareness campaigns. The direct marketing of a point of claim product might not be desirable as it might push the claims up.

It was noticed by the researcher that very few key players involved in SWH programmes in the insurance sector have SWHs installed in their own homes. This was also noted by Holm (2005) among officials working on SWH programmes. The SWH programmes might be more successful if SWH installations at the homes of employees were made a prerequisite, or one of the benefits, of working on a SWH programme, because it is easier for someone to promote a technology that they believe in. The promotion of SWHs to the staff of the insurance company could also serve as a means for identifying potential problems. It will most likely not be possible to make the purchase of a SWH compulsory for staff it could be made more attractive by company subsidising. It might also be useful to introduce a "comply or explain" procedure for the programme. Staff working on SWHs should have one on their own roof, or explain why they are not complying. It is important to shift a SWH, in the mind of both the policyholders as well as staff, from a "might get" to a "must have" item. A SWH programme is a great opportunity to do something different for business success.

It is important that insurance companies opt for high quality SWHs. The risk of failure is not only lower on high quality products but a product that lasts longer is also seen as "green" because the longer it lasts, the lower the environmental impact of the product's 'cradle to grave' existence.

The point of water heater failure is a golden opportunity for municipalities working on SWH systems financed through the municipal billing system to have a significant impact. Not only will this benefit the municipalities in bringing down peak demand of electricity, but it will benefit the ratepayer because the capital cost of the SWHs will be reduced by the replacement value of the failed water heater. Banks, insurance companies and municipalities should work together to put new systems in place for this to work.

Insurance companies spend a lot of money on marketing and sponsorship. Getting their policyholders to change to a SWH offers a great marketing opportunity. Some sponsorship money could even be put to good use for pilot projects or for installations of SWHs in the houses of staff or brokers. One thing that insurance salesmen are notoriously good at, is selling. Some of this energy needs to be harvested and put to use by setting up a successful SWH programme. It is unlikely that a SWH programme will be successful if it is merely offered at the point of a claim.

The decision by the policyholder to change to a SWH at the point of water heater failure is not an easy and straightforward one. Figure 15 is a schematic representation of the different decisions that a policyholder needs to make at the point of water heater failure where a SWH is offered.

Figure 15: Issues influencing the complex system of water heater failure claim and changing to a SWH at this point

As shown in Figure 15, the default position is still the standard electric water heater. At the moment the system is structured to make it as easy as possible to replace a failed water heater with a standard electric water heater. The entire system is geared towards this, and the entire process needs to change. The default installation option needs to be a SWH. Until this happens, and until the entire market changes, the easier and quicker route will always be the more popular one. It is clear from the schematic that it is not only the choice of the policyholder which needs to change. The system needs a complete overhaul.

This much-needed complete change is highly possible and should be the direction which the industry is working towards. It will be easier and quicker to change the entire system than to try to fit the new processes, procurements and installation lines into the old system. The system as it stands now is focused on speed and relies on the fast installation of cheap, low quality water heaters. If all parties are committed to the change to SWHs, the focus needs to change to the procurement and installation of good quality SWHs. These systems will take longer to install and will cost more upfront but, in the long-term, it is the cheaper and better option, not only for the policyholder and the insurance company, but also for the country as a whole.

An entire new way of thinking, and visionary leadership, is required for this opportunity to be used to its full potential. If everyone involved could work together to turn what, at the moment is a mere possibility, into reality, then the outcome would most certainly be a positive one.

Within the context of the theoretical background discussed in Chapter 2.6, the changeover of the system from standard electric water heaters to SWHs could be seen as technological substitution whereby landscape pressure forces a niche innovation which has developed sufficiently to break through and replace the existing regime (Grin *et al* 2010).

An empirical example of this can be seen in the technological substitution path from sailing ships to steamships in Britain (Geels 2002). The new technology (steamships) emerged in small niches (mail transport, inland waterways) while the regime was relatively stable. There was major landscape changes (Suez Canal, mass emigration) and price / performance improvements and substitution occurred because of these. By virtue of the many adjustments in the socio-technical regime that followed the breakthroughs of steamships, the transition took on the character of a technology-push.

SWH technology in South Africa is well developed and available in niches around the country. As was discussed in Chapter 3, the technology is financially a sound proposition. The timing of landscape pressure (regulations, market demand, electricity price) on regimes (insurance industry, water heater industry) to promote a niche technology (SWHs) is important, as discussed in Chapter

2.6. In the case of SWHs, the time for landscape pressure appears to be ripe. SWH technology as a niche innovation is fully developed and all the prerequisites proposed by Grin *et al* (2010) are in place. These prerequisites, discussed in Chapter 2.6, are repeated here for the benefit of the reader:

- The learning process has stabilised and there is a dominant design.
- The support network has been joined by powerful actors.
- The price and performance has been improved on and there are strong expectations of further improvements.
- The innovation is already used in market niches. These niches add up to more than 5% of the market share.

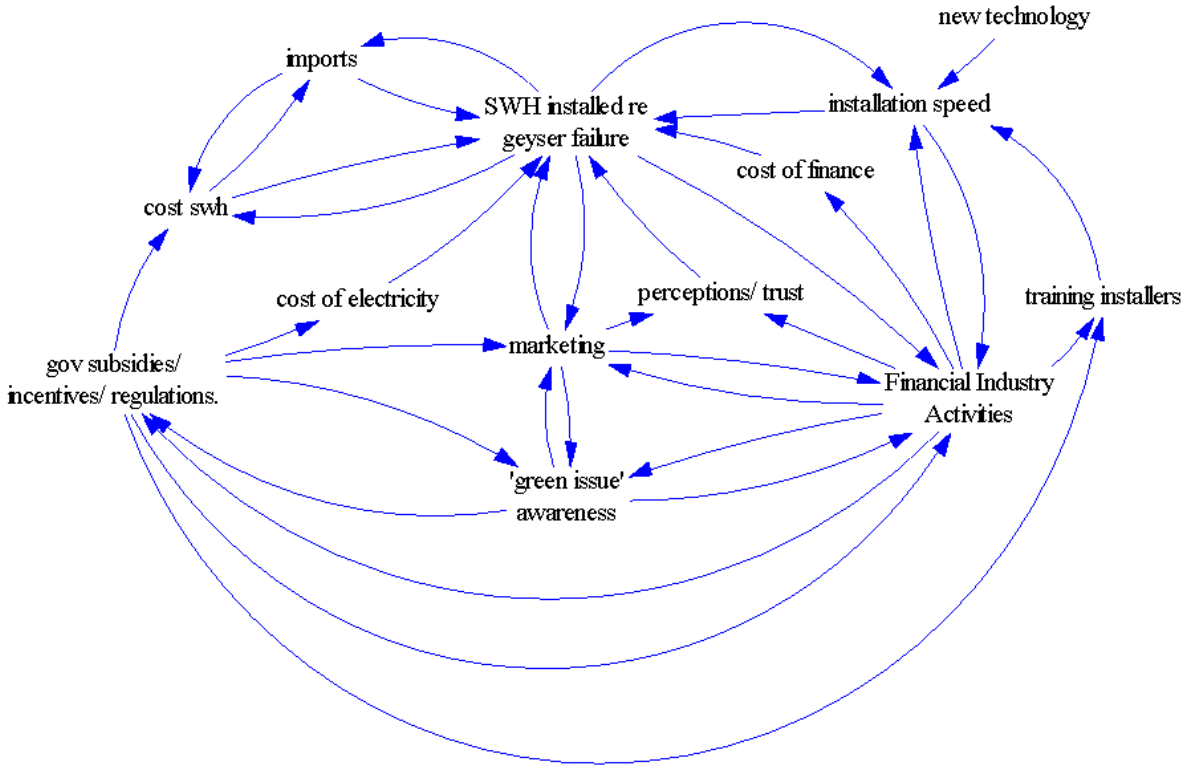
As pointed out by Grin *et al* (2010), whether or not a technology is fully developed is not necessarily an objective matter, and the opinions of niche actors (SWH agents) and that of the regime (water heater manufacturers, insurance companies) might vary.

5.3 System dynamics

System dynamics is a method used for understanding the behaviour of complex systems over time. It identifies internal feedback loops that affect the behaviour of the whole system. It is a non-linear way of looking at systems, and the feedback loops help to describe how even seemingly simple systems display unexpected non-linearity. If a complex, dynamic and circular system is linearised, it may seem simpler and easier to understand but there is an inherent risk that the very reality that the researcher seeks to understand is totally misread. One way of visually showing these complex systems is with a causal loop diagram (Kim 1992).

Insurance companies' SWH programmes are not the only determinant of the number of installations of SWHs in South Africa. These installations are components of a complex system, and any part of the system can have an effect on the other parts. A causal loop diagram (**Error! Reference source not found.**) was drawn up for the complex system of transition to SWHs via insurance claims for failed water heaters in collaboration with the help of a fellow student, Valerie Payn (Payn 2010b). By studying the causal loop diagram in **Error! Reference source not found.**, it can be seen how everything is inter-connected. To follow the diagram, one needs to follow the arrows which show the feedback loops between all the different components.

Figure 16: Factors affecting number of installations of SWH via the insurance industry



Schematic done with the kind help of Valerie Payn (Payn 2010b)

The causal loop diagram's story is revealed by following each of the feedback loops. For instance:

- The number of SWHs installed via the insurance industry affects imports, which affects costs of SWHs, which affects the installations via the insurance industry. The installations of SWHs via the insurance industry could also directly affect costs, which affect imports and so on.
- The installation speed is affected by training of installers, new technology and activities within the financial industry.
- The cost of SWHs is affected by imports, government subsidies and installations of SWHs via the insurance industry. It is, of course, also affected by the general supply and demand for SWHs in the country (which is affected by the amount of SWHs installed by the insurance industry).
- Government subsidies, incentives and regulations are affected by green issue awareness and marketing (via green issue awareness) and the financial industry activities. Government policy also affects cost of electricity that feeds back to affect the amount of SWHs installed by the insurance industry.

- Marketing is affected by and affects the installations of SWHs via the insurance industry; it is also affected by, and affects, 'green issue' awareness and the financial industry activities. Marketing of SWHs is also affected by (and affects via green awareness) government subsidies, incentives and regulation. Marketing will also affect perception and trust in SWH technology, which affects the installations of SWH by the insurance industry and also affects and is affected by the financial industry activities.
- The financial industry activities are affected by the installations of SWH via the insurance industry and affect same via cost of finance. It also affects perceptions and trust in SWH technologies, affects and is affected by government subsidies and regulations, and could affect the training of installers and the installation speed.

The causal loop diagram shown in Figure 16 is only one representation of the complex system and by no means incorporates all of the dynamics within the system. It is, however, a useful tool to attempt to illustrate the complex dynamics involved.

5.4 Chapter summary

The overwhelmingly dominant view within all sectors involved in SWHs (regulators, insurance industry, financial institutions and the SWH industry itself) is that the low uptake of SWHs is due to the high upfront cost. It has been shown, however (Chapter 3), that SWH technology is in fact the more economical option. If the insurance payout due to a failed water heater is taken into account, it becomes even more financially viable for the policyholder, yet the uptake of SWHs is still very low in South Africa.

The entire system is geared towards supplying a standard electric water heater in the event of a failed water heater, and these entrenched habits are very difficult to break. The system is dynamically stable and will resist change. Due to this, pressure from the landscape level is needed to change the socio-technical processes of the regime.

The complex dynamic and stable socio-technical system (the insurance industry supplying standard electric water heaters to households with failed water heaters) needs to be understood in its entirety. Only if the system is understood can influence be exerted on the system to change. The multi-level perspective of socio-technical systems and, in particular, the theory of technological "lock-in" is helpful in this regard.

Systems thinking, where the entire system is seen in a non-linear way with positive and negative feedback loops may also be a helpful tool for improving our understanding of the system.

Chapter 6: Conclusions and Recommendations

6.1 Conclusions

Knowledge is acquired in a non-linear fashion. It involves a variety of stakeholders and it is a complex and interactive process. Knowledge is only integrated by regular interactions between theoretical knowledge, practical knowledge and practical experience. Through this process, an innovation might break through to establish itself at the level of the societal system. Social learning forms an essential part of such a process of non-linear knowledge. This is not learning in the sense of the transfer of knowledge, but learning in terms of developing the exchange of ideas and interaction with other views of reality (Grin *et al* 2010).

This study has explored the possibility of the insurance industry in South Africa acting as a SWH driver. A literature review served to develop the researcher's understanding of the background to the SWH industry worldwide, its policy and regulatory framework, and its context and meaning through references to climate change, corporate social responsibility and transitions in socio-technological systems. A series of interviews, undertaken with key stakeholders in the insurance industry and other relevant entities, surfaced a number of issues that support the suggestion that the South African insurance industry has the capacity and opportunity to drive the penetration of SWH technology. The system, however, finds itself in a lock-in situation where it is entirely geared towards providing a certain product provided by certain suppliers, and it is extremely resistant to change.

The insurance industry is responsible for the procurement and installation of more than 75% of replacements and almost 50% of all standard electric water heaters sold in South Africa. Water heaters are insured through homeowners policies, and 70% of claims on these policies are water heater related.

The interviews revealed that most of the big insurance companies in South Africa are investigating the possibility of running a SWH programme at point of claim. Some companies are even considering initiating a pro-active programme for replacement of water heaters with SWHs before they fail. Santam, one of South Africa's leading insurers, has an in-house SWH programme running countrywide while Absa Insurance, the largest homeowners insurer in the country, has a pilot project running in Cape Town.

When a policyholder changes to a SWH at the point of water heater failure, and they are insured through one of the abovementioned programmes, not only will the insurance value of the failed water heater be taken off the price of the new SWH, but the Eskom subsidy will also be financed

and administered on behalf of the policyholder by the insurance company. Financially this is a very attractive offer for the policyholder because the monthly electricity saving will give a very good and rising return on their capital investment. The only possible inconvenience is that they might have to wait slightly longer for the installation of a SWH than they would have waited for that of a standard electric water heater. Installing a SWH on the roof of a policyholder's house will also be financially beneficial to the insurer because the risks associated with resultant damage caused by a failing water heater will fall away. Resultant damages can account for up to 50% of the cost of total claims for failed water heaters. If a SWH is well maintained it should last longer than a standard water heater. In the future it might even be possible to register SWH programmes for carbon credits and benefit financially from selling off the carbon emissions saved by the installations of these SWHs.

Increased penetration of SWHs in South Africa will not only take the pressure off the already stressed electricity supply but will also lower the carbon emissions of the country as a whole. The current penetration of SWHs in this country and total annual sales of SWHs, are very low despite these potential benefits. The number of SWHs installed in place of failed water heaters is less than one percent of the total number of replacement installations.

High initial cost of the SWHs is frequently cited as the reason for the low uptake. This apparent obstacle disappears if one considers the totality of the transaction. Since a capital cost reduction equivalent to the value of the failed water heater is taken as a discount on the SWH, it is financially a more viable option for many policyholders to change to a SWH at the point of water heater failure than any other time. Fears about high initial capital cost arise from consumer perceptions that are part of a systemic logic which is configured to reinforce these perceptions. The monthly electricity savings achieved through use of a SWH very quickly serve to offset this high initial price, and will be realised even sooner when electricity tariffs rise. Many insurance companies are affiliated to banks and could offer policyholders a financing product to assist with the upfront cost. The initial capital cost could thus be seen by the policyholder as an investment with a growing return in the form of the rising monthly electricity saving. However, in order to exploit these benefits, consumers need to be well informed. This would help to dispel their negative perceptions as well as expose them to the opportunities.

A number of additional obstacles to the uptake of SWHs at the point of claim were identified. Many of these obstacles coincide with those for the uptake of SWHs in general in South Africa. They include perceived aesthetic issues, particularly in middle-income residential areas. The orientations of a few residential buildings would also make the capture of solar energy a challenge. This problem is exacerbated when adjacent natural or man-made features cast shadows. Additionally, the vast choice of systems offered to the consumers could be confusing to some people, potentially

causing consumers to defer their decision. This could happen even with consumers who may have already made the decision to change to a SWH. Added to all this is the potentially longer waiting time for the SWH installation. Some policyholders resort to having the water heater replaced by a plumber before submitting the claim to the insurance company.

As the awareness of SWH products and benefits is still very low, many policyholders just do not seem to think of it as an option, even at the point of water heater failure. Many policyholders submit their claims via an insurance broker and do not deal with the insurance company directly. These insurance brokers might not have an incentive to relay the offer of a SWH to the client. If policyholders do not have a long-term vision for improving their house or do not occupy the property themselves, they might not be the ones who would benefit from the electricity savings and therefore might not be as willing to make the change. It was found in both of the SWH programmes run via insurance companies that many homeowners in South Africa do not seem to be interested in hearing about a SWH.

Notwithstanding, some movement in the SWH market is starting to emerge. Due to the increase in the electricity price and the doubling of the Eskom SWH subsidy, the awareness of SWHs is rising and SWHs are becoming more affordable to South Africans. In both of the SWH programmes running via insurance companies, it was found that some policyholders had already installed a SWH through another SWH company, which they found on their own before being offered a SWH by the insurance company. Other policyholders declined the offer from the insurer and decided to use a SWH installation company of their choice, for unknown reasons.

Insurance companies are risk managers and climate change will have an impact, not only on their profitability but also, on their sustainability. Thus the industry stands to gain from climate change mitigation. It is also becoming more important for all companies, including the insurance sector, to focus not only on maximising profits but on other aspects of their business as well. This includes social responsibility and environmental sustainability. How a company makes money is becoming as important as how much it makes. Clients and shareholders might start looking at these company values when they make decisions about where to take their business. None of the obstacles listed above are impossible to overcome. Most insurance companies and other financial institutions in South Africa seem to be investigating SWH programmes. It appears that these companies are promoting the uptake of SWHs but are not having much success in their endeavours. It is apparent that a number of opportunity gaps exist. One example is consumer awareness and sensitisation. Insurance companies spend vast amounts of money on extensive advertising campaigns and sponsorship of major sporting events. It is noteworthy that no equivalent investment in SWH or environmental awareness programmes has been made.

Significant funds are also invested in advertising insurance policies and products that people already know about. It is therefore reasonable to infer that, up until now, SWHs are not awarded the same priority by the South African insurance industry as their traditional products. This offers a great opportunity for improvement. In order to accelerate the installations of SWHs in general in the country, much more consumer awareness and education is needed. If the system could change and the insurance industry can put in a concerted and serious effort, SWHs could be the water heating solution of choice. These awareness campaigns could be co-ordinated to augment existing and future government programmes. However, the logic of the current system, and the way it works, reinforces entrenched perceptions. The entire system is geared towards supplying a standard water heater in the shortest possible time. It might look as if the insurance industry is not doing enough to promote SWHs. They are, however working against an entrenched system, which is extremely difficult to change from within.

This author learnt through this research that one of the few attempts to promote solar water heaters is through insurance company call-centre operators. These operators have been extensively trained to offer a SWH when a water heater claim is lodged. It became apparent from the investigation that the selling of the idea needs to happen sooner. The call-centre operators are not sales people and therefore not in the position to sell the SWH programme to the policyholders. In addition to this, many of the claims are lodged by insurance brokers and not by the policyholder themselves. It is quite possible that the offer of SWHs is not relayed to the policyholders. Because SWH technology has a very low penetration in South Africa and is still an unknown technology, not many insurance brokers or policyholders phoning in can recognise the benefit of a SWH installation. When the additional capital outlay is mentioned, this is likely to be interpreted as an extra cost and not the investment that it really is.

By the time that the claim is lodged, the policyholder should already be aware of the offer and he/she should already have been convinced of the benefits of changing to a SWH. This will only be achieved with extensive marketing campaigns on radio, television and the print media. Direct marketing to policyholders through e-mails or offers via the brokers could also be considered. The insurance industry is notoriously good at selling policies. This same marketing skill could be harnessed and used in the selling of SWH programmes to the policyholders. Such a marketing campaign, if cleverly designed and if the company can deliver what is offered, could have the added benefit of selling more policies. It must, however me noted that extensive marketing for a point of claim product might influence the amount of claims.

As an added incentive to the rising electricity tariffs, the anticipated national building regulation to be put in place in 2011 could help in increasing awareness and knowledge about SWHs. Either one

these factors might just prove to be the landscape shock that the system needs for transition to happen.

The active promotion of SWHs should be high on all stakeholders' agenda. Government, Eskom, Energy Efficiency and renewable energy industry bodies, financial institution and the insurance industry should all work together at promoting the installations and use of SWHs. They should in addition work together at putting the logistics in place to cater for the expected increase in demand.

Systems thinking, where the entire system is seen in a non-linear way with positive and negative feedback loops, is a useful tool that can shed light on our understanding of the system. For this purpose a causal loop diagram was drawn up in an attempt to present this dynamically stable, circular system with its positive and negative feedback loops. It emerges from this causal loop diagram that the system and influences on it is far wider than merely the insurance, water heater and SWH industries. There are many other sectors which influence this system.

The system that supports a water heater claim works like a well-oiled machine and is geared towards supplying a standard electric water heater to a policyholder. This system is robust and stable (though dynamic) and it is extremely resistant to change. The obstacles to the wide spread uptake of SWHs at point of water heater failure are all emergent properties of the logic of the system that reproduces perceptions about water heating and SWHs.

The complex dynamic and stable socio-technical system (the insurance industry supplying standard electric water heaters to households with failed water heaters) needs to be understood in its entirety. Only if the system is understood, can influence be exerted on the system to change. The multi-level perspective of socio-technical systems and, in particular, the theory of technological "lock-in", is helpful in this regard.

The key concept of the multi-level framework for analysis of technological transitions is that transitions occur on three levels. The new technology develops at the niche level. This level has protection against market forces and the new technology is free to evolve and develop. Although change happens more slowly at the higher levels, the relationships between levels are closely interwoven. Only once the different dynamics come together in very particular ways will a mutual reinforcement effect emerge; this is a condition which is necessary for transition to take place.

SWH technology in the South African context could be seen as settled in at the niche level. The mainstream socio-technical institutions are referred to as the regime level. Everything on this level serves to support mainstream technologies. This is where the dominant technology is used. The regime is usually stable, yet dynamic and is resistant to change. In the context of this research, the

insurance industries, the insurance brokers, the water heater installers and the electric water heater manufacturers amongst others, make up the regime level. The third level is referred to as the landscape level. This level represents the external environment of factors and processes that influence both niches and regimes. It is the level of macro-system dynamics, for instance economic growth, broad political coalitions, cultural values and environmental problems. A shock to the system is needed to force the regime to change and adopt a niche technology. This shock could come from the landscape level. The niche technology has to, however, be sufficiently developed to take over and become the technology of choice. Transitions involve changes in structures and practice and they are very complex phenomena.

SWH technology in South Africa is sufficiently developed to take over from standard electric water heaters. A landscape shock to the system is, however, needed for this to happen. The rapidly increasing electricity price or the energy efficient regulations for new buildings might just be a sufficient landscape change.

In this study, the empirical research suggests that the insurance industry has failed to be a driver in mainstreaming SWH technology because a vast, complex, finely tuned set of interlocking systems have emerged over a long period of time that effectively deliver a specific water heating solution (manufactured almost entirely by one company). For this system to change, an external shock is needed.

The widespread installations of SWHs in South Africa will have a beneficial impact on both our electricity supply capacity and our carbon emission problems. For this reason, the installation of SWH should be encouraged on all levels. Because the insurance industry is responsible for about half of all standard electric water heaters installed in South Africa, this represents an opportunity for large scale intervention.

6.2 Suggested interventions

The core issue that is preventing the insurance industry from becoming a SWH driver in South Africa is the systemic logic. Even though it appears that a change to SWHs will be beneficial to both the policyholder and the insurance company, the system is geared to providing a standard electric water heater to the policyholder. Because this system is resistant to change, it might take an external shock for SWHs to become the dominant technology installed by the insurance industry to replace failed water heaters.

This shock to the system could be aided by interventions that target a change in the current system's logic.

Some suggested interventions are listed below.

- It is very difficult to access accurate statistics both for standard electric water heater installations and for SWHs in South Africa. The last reliable, comprehensive study of this kind was done by Holm in 2005. Research into the size of installations as well as annual sales could be very useful in this regard. This will enable agents to determine whether the SWH industry is in fact robust enough to become the dominant technology.

- Marketing and awareness campaigns have been identified in this study as a major requirement for the establishment of a successful SWH industry in South Africa. Investigations are needed as to the best way to achieve successful campaigns.

- Investigations are needed into the reasons why more policyholders decide to go with outside SWH companies and not through the insurer's suppliers, so as to improve the systems used.

- The regulatory environment in South Africa should be investigated to find ways in which the insurance industry can be forced to replace standard electric water heaters with energy-efficient hot water solutions at the point of water heater failure.

- An investigation into the standards for SWHs as applicable to quality of materials, as well as efficiency, should be undertaken. If all SWHs in South Africa could be graded in terms of these specifications, it will reduce confusion in the market and consumers will know what they are buying.

- The possibility of a pro-active approach from the insurance industry for the replacement of water heaters by SWH should be investigated. This might involve replacing all water heaters older than a certain number of years with SWH, as the risk of these water heaters failing in the near future are high and it might be to the advantage of both the insurer and the insured to replace these before they fail. The legality of such a scheme should be investigated, as it might be illegal for an insurer to replace a working appliance.

- The pre-authorisation for SWHs might be useful to the insurance industry. If the home of a policyholder has been pre-authorised for the installation of a SWH, this will save time in the event of water heater failure. Homes could be scanned for orientation, roof angle and roof structure, amongst other factors. An investigation in the possibility of this, either through site visits or through GIS technology or Google maps should be investigated. In this way, the

households to which the offer is made could be filtered to exclude those where a SWH would be inappropriate in the first place. This could cut down the cost to the insurance company per claim, both at the call-centre point and in call-out cost for quotes for the SWH.

- Further investigation is needed to include the one million low-income households who have water heaters in their homes in the formal insurance market. This could mean new business to the insurance industry and could in addition give these consumers peace of mind that their homes are insured. This will bring their water heaters into the hands of the insurance sector to replace with SWHs if possible.

- The possibility of "green bonds" in addition offers scope for further research. It might be considered that policyholders who opt to install a SWH are more reliable as they put future benefits before upfront costs. Financial institutions could benefit from doing business with such persons and could thus offer them better rates.

- An investigation could be undertaken into the possibility of changing the National Credit Act of 2007 to take the future monetary saving due to the installation of a SWH into account when determining a person's credit rating.

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Appendices

Appendix 1: Interviews

Insurance industry interviews

Date	Name	Place	Organisation	Position	Recorded	Transcript
10/02/04	Adi Enthoven	Johannesburg	Capricorn Venture Investments (Shareholder of Hollard Insurance)	Chairman	yes	no
10/02/04	Anton Botha	Johannesburg	Hollard Insurance		yes	no
10/02/04	Frans Prinsloo	Johannesburg	Hollard Insurance		yes	no
10/02/04	V. Geen	Johannesburg	National Business Initiative (NBI)	Director: Climate and Energy	yes	yes
10/02/04	F. Botha	Johannesburg	FNB	Head: Acquisition and Channel Management	no	no
11/02/23	G. Aquisto	Telephone	Fogi	Owner	yes	yes
10/03/12	P. Kuhn	Telephone	Standard Bank	Public Sector Infrastructure Advisory	yes	yes
10/04/14	M. Louw	Johannesburg	Nedbank Group	Environmental Strategy Consultant	no	no
10/04/14	R. Moletsane	Johannesburg	South African Insurance Association (SAIA)	Deputy Executive Officer	yes	no
10/04/14	E. Harkema	Johannesburg	Hollard Insurance	General Manager: Short-term Insurance Actuarial Team	yes	no
10/05/21	R. Sedres	Cape Town	Santam Ltd	Head: Sustainability and CSI	no	no
10/05/29	G. Genis	Cape Town	Santam Ltd	Head: Quality Management	yes	no
10/06/03	M. Addison	Telephone	Addsure	Director	yes	no
10/06/09	E. Lee	Cape Town	Santam Ltd	Strategic Intelligence Analyst	yes	no
10/06/09	V. Otto-Mentz	Cape Town	Santam Ltd	Head: Santam Strategy Unit	yes	no
10/06/30	A. de Beer	Cape Town	Santam Ltd	Head: Enterprise risk management	yes	no
10/07/01	M. Martins	Telephone	Absa	Head: Sustainability (Corporate Affairs and Sustainability)	yes	no

Date	Name	Place	Organisation	Position	Recorded	Transcript
10/07/06	B. Bozonne	Telephone	Capricorn Venture Investments (Shareholder of Hollard Insurance)	SWH Project	yes	no
10/07/06	N. Goldin	Telephone	Capricorn Venture Investments (Shareholder of Hollard Insurance)	SWH Project	yes	no
10/07/27	G. Genis	Cape Town	Santam Ltd	Head: Quality Management	no	no
10/07/30	G. Aquisto	Telephone	Fogi	Owner	no	no
10/08/18	A. Craven-Sutton	Johannesburg	Absa Insurance	Procurement Specialist	yes	yes
10/08/18	A. de Ridder	Johannesburg	Absa Insurance	Manager Specialist Procurement	yes	yes

SWH Industry Interviews

Date	Name	Place	Organisation	Position	Recorded	Transcript
10/02/02	F. Spencer	Somerset Vest	Emergent Energy	CEO	no	no
10/03/09	D. Holm	Johannesburg	ISES	SOLTRAIN Southern Africa and SESSA organiser	no	no
10/04/06	R. Dearlove	Telephone	Solar Heat	Training	yes	yes
10/06/04	H. Hertzog	Telephone	Atlantic Solar	Owner	yes	no
10/07/12	H. Hertzog	Telephone	Atlantic Solar	Owner	yes	no

Government employees Interviews

Date	Name	Place	Organisation	Position	Recorded	Transcript
10/04/14	M. Roux	Johannesburg	Department: Public Enterprises	Manager: Solar Waster Heater Project	yes	no
10/04/22	S. van der Merwe	Telephone	Nelson Mandela Bay Metropole	Energy Department	yes	no
10/04/29	C. Schmidt	Telephone	Nelson Mandela Bay Metropole	Energy Department	yes	no
10/04/29	S. Kuzyayo	Telephone	Central Energy Fund	Carbon Specialist	yes	no
10/08/11	M. Ndlovu	Cape Town	Eskom	Demand Side Management	no	no

Renewable Energy Companies Interviews

Date	Name	Place	Organisation	Position	Recorded	Transcript
10/04/22	K. Ross	Telephone	Global Carbon Exchange	Energy Engineer	yes	no

Date	Name	Place	Organisation	Position	Recorded	Transcript
10/06/07	L. Jennings	Telephone	Sustainable Energy Africa	Project Manager	yes	no
10/09/02	D. Abel	Telephone	Unlimited Energy	Director	no	no

Appendix 2: E-mail correspondence

Name	Position	E-mail address

Insurance / banking sector

Hollard Insurance and Capricorn Venture Investments (shareholder of Hollard Insurance)

A. Enthoven	Chairman, Capricorn Venture Investments	Adrian@spier.co.za
B. Bozonne	Capricorn Venture Investments	BiancaB@hollard.co.za
N. Goldin	Capricorn Venture Investments	NickyG@hollard.co.za
E. Harkema	General Manager: Short-term Insurance Actuarial Team, Hollard Insurance	ErikH@hollard.co.za
A. Botha	Hollard Insurance	AntonB@hollard.co.za

Absa

M. Martins	Head: Sustainability (Corporate Affairs and Sustainability)	miguelm@absa.co.za
A. de Ridder	Manager Specialist Procurement	Arie.DeRidder@absa.co.za
A. Craven-Sutton	Procurement Specialist	Anna.Craven-Sutton@absa.co.za

Santam

V. Otto-Mentz	Head: Santam Strategy Unit	Vanessa.Otto-Mentz@santam.co.za
G. Genis	Head: Quality Management	Gerhard.Genis@santam.co.za
A. de Beer	Head: Enterprise risk management	Annelize.DeBeer@santam.co.za
D. van Wyk	Quality, Service and Compliance Manager, Quality Assurance	Denise.vanWyk@santam.co.za
E. Lee	Strategic Intelligence Analyst	Edmond.Lee@santam.co.za
A. October	Procurement Manager: Building	Andre.October@santam.co.za

Standard Bank

P. Kuhn	Public Sector Infrastructure Advisory	Paula.Kuhn@standardbank.co.za

FNB

F. Botha	Head: Acquisition and Channel Management	Fbotha@fnb.co.za

Nedbank

M. Louw	Environmental Strategy Consultant	MeganL@Nedbank.co.za

Fogi

G. Aquisto	Owner	gio@fogi.co.za

Bridging Capital

D. Baylis	Director	dudley.baylis@bcrefco.co.za

Innovations Group

W. Krambeck	Executive PA to CEOSA	krambeckw@za.innovation-group.com

South African Insurance Association

R. Moletsane	Deputy Executive Officer	Refilwe@saia.co.za
A. Joubert	Public Relations Officer	Adele@saia.co.za

The Banking Association South Africa

P. Venter	General Manager: Human Settlements	PierreV@banking.org.za

SWH Industry interviews

F Spencer	CEO, Emergent Energy	frank@emergy.co.za
J. de Villiers	Owner, Euroheat	jacques@euroheat.co.za
L.R. Schultz	Marketing Manager, Kwikot	lionel.schultz@kwikot.com
C. van Zanten	Project Manager, Solar: Kwikot	charles.vzanten@kwikot.com
W. Weiss	SOLTRAIN and AEE – Institut für Nachhaltige Technologien (Austria)	w.weiss@aee.at

Sustainble Energy Society of South Africa Solar Water Heater Division (SESSA SWHD)

R. Thomson	Treasurer SESSA SWHD and Sunpower	robin@sunpower.co.za
J. Ledger	Chairperson, SESSA and Associate Professor of Energy Studies – University of Johannesburg	john.ledger@wol.co.za
D. Holm	SOLTRAIN co-ordinator Southern Africa and SESSA organiser for Gauteng, ISES	dieterholm@worldonline.co.za
H. Hertzog	Board member of SESSA and owner of Atlantic Solar	Helmuth@atlanticsolar.co.za

Government and regulators

City of Cape Town

S. Ward	Head: Energy and Climate Change Branch, Environmental Resource Management Dept	Sarah.Ward@capetown.gov.za
W. Roggen	Principal (Renewable Energy and Energy Efficiency), Environmental Resource Management Department	Wouter.Roggen@capetown.gov.za

Department: Public Enterprise

M. Roux	Manager: Solar Waster Heater Project	Marie@whitezulu.co.za

Eskom

C. Worthman	Demand Side Management	Cedric.Worthmann@eskom.co.za

National Regulator for Compulsory Specifications (NRCS)

A. Cohen	NRCS	COHENAG@nrcs.org.za

South African Bureau of Standards (SABS)

K. Deist	Head of Laboratory, Technical Specialist: Plumbing, Pipes, Mech,Water metres and Solar laboratory	DEISTKCF@sabs.co.za

Development Bank of Southern Africa (DBSA)

Y. Afrane-Okese	Regional Director: Energy and Environment Partnership with S/E Africa	YawA@dbsa.org

Renewable Energy Companies

G. Morris	Director, AGAMA Energy	glynn.morris@agama.co.za
M. van Eldik	Programme Manager, Heat Pumps: M-Tech Industrial	mve@mtechindustrial.com
D. Abel	Director, Unlimited Energy	Duncan@unlimitedenergy.co.za

Appendix 3: Justification of monthly saving due to a SWH

The saving potential of a SWH is directly dependent on the hot water use of the occupants of the house. In environmentally and financially conscious households, the hot water use has often been brought down to the minimum by taking a shower instead of a bath, installing low-flow shower heads, adding a water heater blanket and insulating the hot water pipes, using a dishwasher, washing clothes in cold water, switching the water heater thermostat to a lower temperature and switching the water heater off when not needed. In this way, the electricity use for hot water can be dramatically reduced. The monthly or yearly saving of electricity that can be achieved through the use of a SWH is thus not set. In literature it is quoted to be as low as 140 KWh to 400 KWh per month (Holm 2005), up to 800 KWh per month for a home with 5 occupants (Rankin & Eldik 2008).

The SOP assumes an average monthly saving of 200 KWh but it has a provision for this to be changed.

If a 200ℓ SWH is installed, and all of this water is used every day, and the energy to heat this water comes from the sun 70% of the time, then the daily saving will be the electricity it would have used to heat 70% of 200ℓ = 140ℓ

The electricity needed to heat 140ℓ from 15º to 65º C (by 50º) degrees is:

4.2 x 140 x 50 = 29 400 kJ

= 29.4 MJ

1KWh = 3.6 MJ

So it is 29.4 / 3.6 = 8.16 KWh per day

Which is 245 KWh electricity saving per month

The same calculation is used for a 300ℓ SWH:

4.3 x 210 x 50 = 44 100 kJ

= 44.1 MJ

1 KWh = 3.6 MJ

So it is 44.1 / 3.6 = 12.25 KWh per day

Which is 368 KWh electricity saving per month.

If the hot water use per occupant in a house is taken as 70ℓ per day on average, then the electricity saved per day per person will be:

4.4 x 49 x 50 = 10 290 kJ

= 10.29 MJ

1KWh = 3.6 MJ

So it is 10.29 / 3.6 = 2.86 KWh per day

This gives you 86 KWh per person per month saved by a SWH in comparison with a standard water heater.

As it is possible to have never ending permutations of electricity savings, a certain average needs to be decided on. In calculations in this chapter, the monthly savings for a cheaper unit is taken as 250 KWh per month on average and that for a more expensive one is taken as 350 KWh per month. See Appendix 5 for more detailed graphs.

Appendix 4: Financial calculations for SWH options with low hot water usage

The hot water need of every household differs. In this thesis the average electricity saving due to hot water usage due to a SWH was taken at 250 KWh per month. As this is an average, there will be many people who will not realise this saving. In the case where a person lives alone, has a low flow showerhead and takes showers instead of bathing, washes clothes in cold water and has the water heater thermostat set at 55 degrees Celsius, the electricity saving will be much lower if a SWH should be installed.

If the hot water use for this house is taken as 40ℓ per day on average, then the electricity saved per day will be:

4.2 x 28 x 40 = 4 704 kJ

= 4.704 MJ

1 KWh = 3.6 MJ

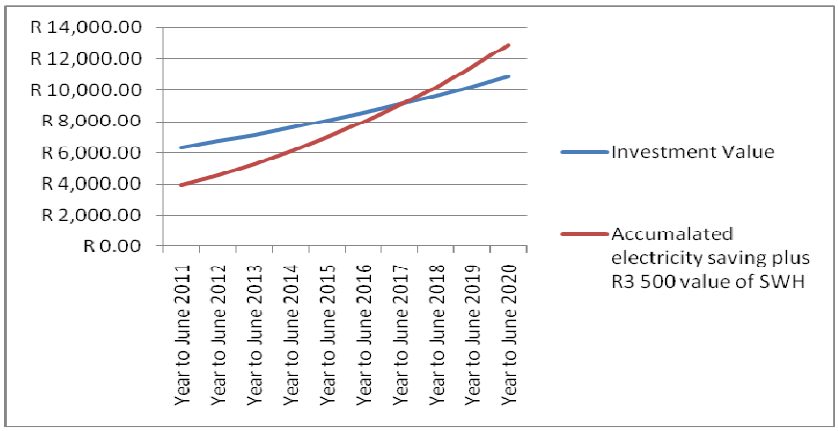
So it is 4.704 / 3.6 = 1.307 KWh per day

Which is 39 KWh per month.

As the hot water needs for this person is very low, at 40ℓ per day, a small SWH would suffice to fulfil this need. It is estimated that this SWH will cost R6 000 including installation. It is further estimated that the installed SWH will have a resale value in the case where it is no longer needed of R3 500. In this extreme scenario it will still be a better investment for the homeowner to install a SWH instead of a standard water heater.

The value of the investment in a SWH will overtake the investment in a bank account @ 6% after 7 years. See figure 2.1 below.

Figure 2.1: R6 000 invested at 6% vs. Buying a SWH at R6 000 with a R3 500 resale value and electricity saving of 39 KWh per month.



This calculation was merely done to prove that even in cases of extremely low how water use, it is still financially beneficial to install a SWH. In addition to this, due to the extreme low hot water use, it could be assumed that the person living in this house is energy conscious and might be willing to install a SWH even if it should cost more in the short-term. The R6 000 price of a small SWH is also very close to the price of a standard electric water heater including installation.

Appendix 5: Total cost to owner compared to total accumulated electricity saving for different SWH scenarios

Figure 3.1: High end 300ℓ SWH – no subsidy, no insurance payout benefit

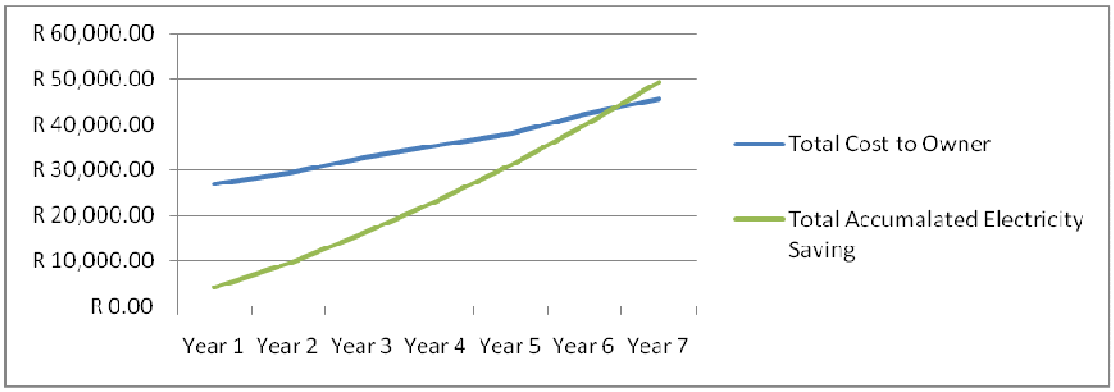


Figure 3.2: High end 300ℓ SWH – no subsidy, including insurance payout benefit

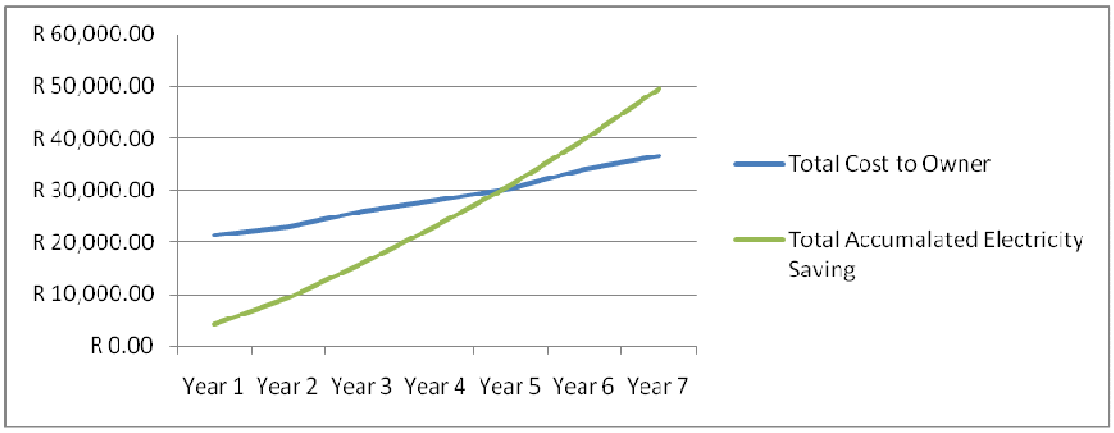


Figure 3.3: High end 300ℓ SWH – with Eskom subsidy, no insurance payout benefit

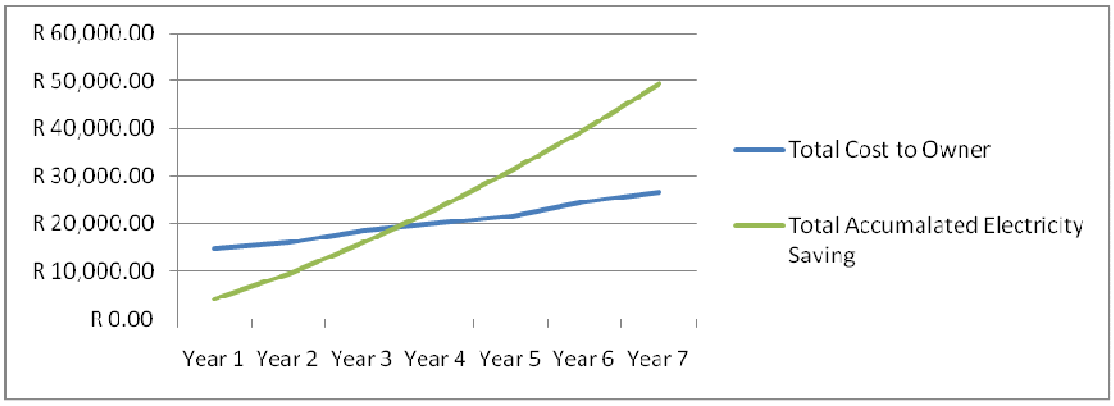


Figure 3.4: High end 300ℓ SWH – with Eskom subsidy, including insurance payout benefit

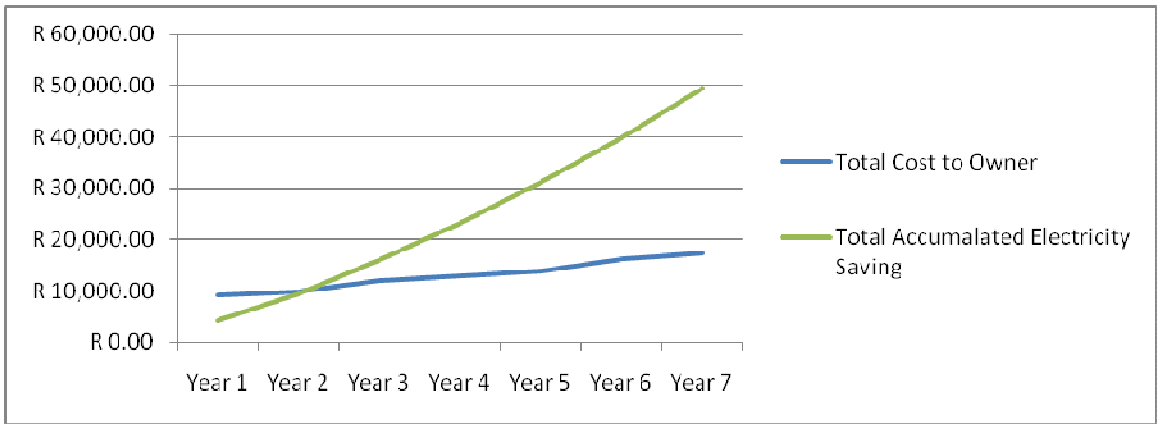


Figure 3.5: High end 300ℓ SWH – SOP included, no insurance payout benefit

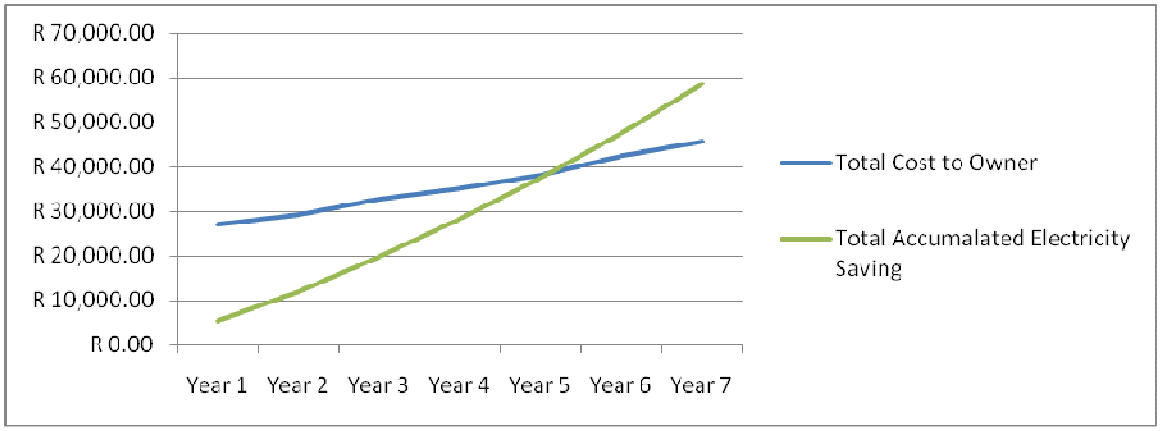


Figure 3.6: High end 300ℓ SWH – SOP, including insurance payout benefit

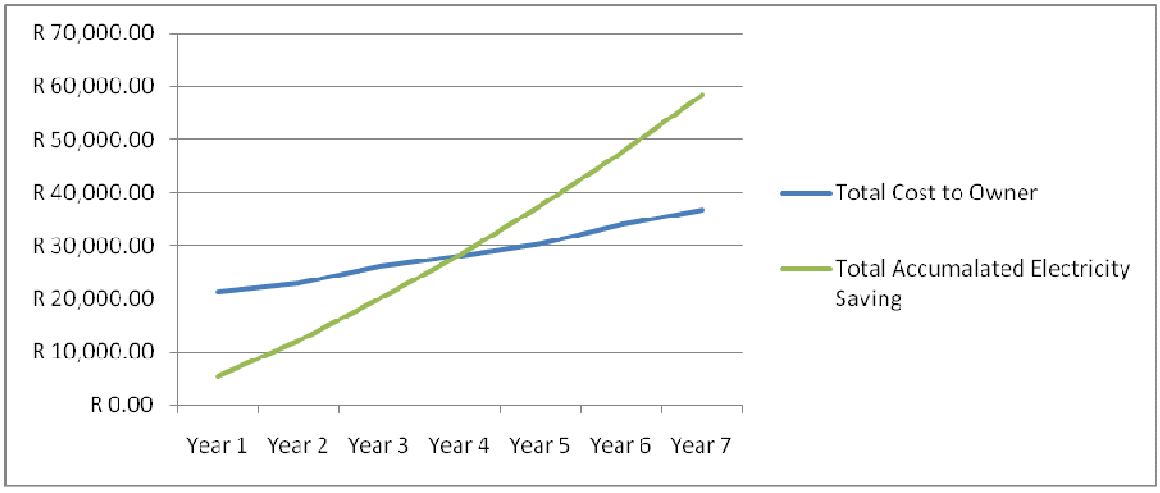


Figure 3.7: Lower end 200ℓ SWH – no subsidy, no insurance payout benefit

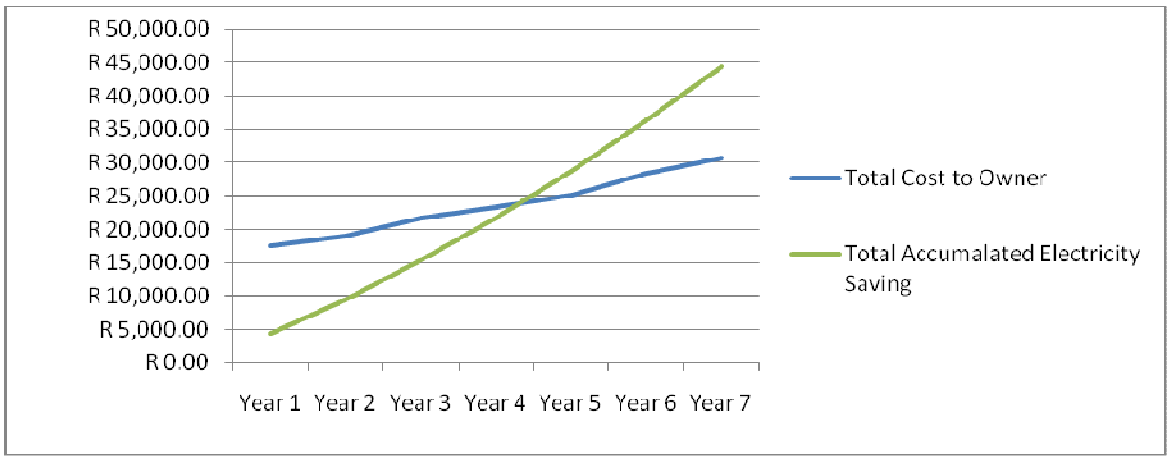


Figure 3.8: Lower end 200ℓ SWH – no subsidy, including insurance payout benefit

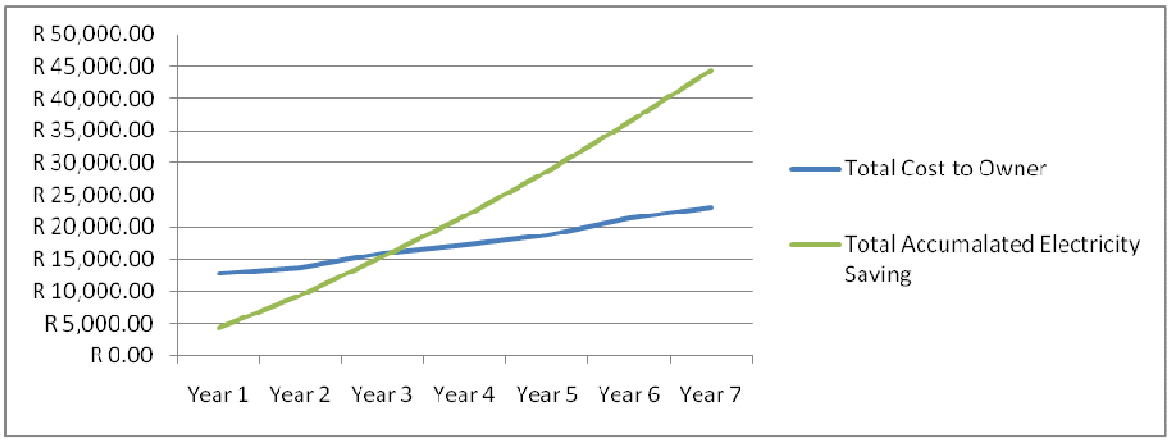


Figure 3.9: Lower end 200ℓ SWH – including Eskom subsidy, no insurance payout benefit

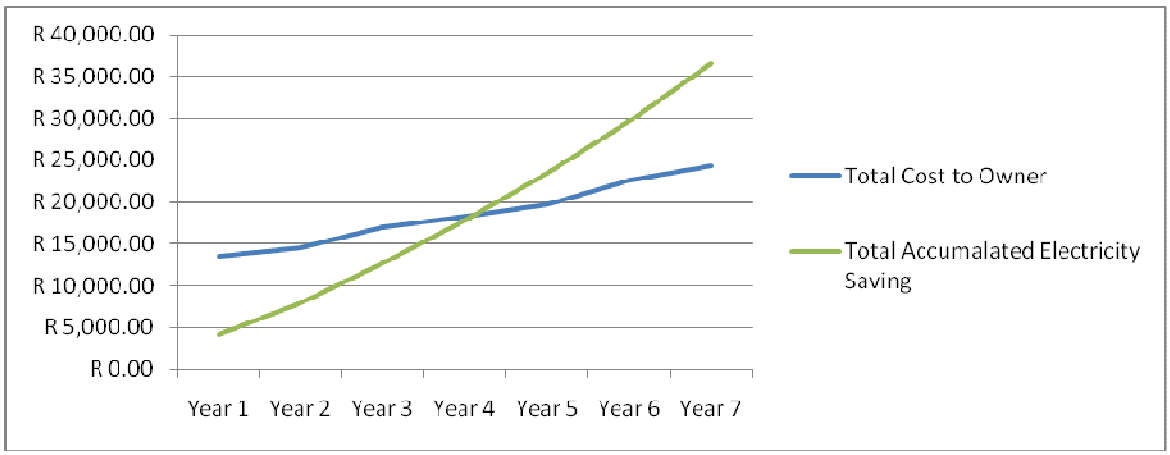


Figure 3.10: Lower end 200ℓ SWH – including Eskom subsidy, with insurance payout benefit

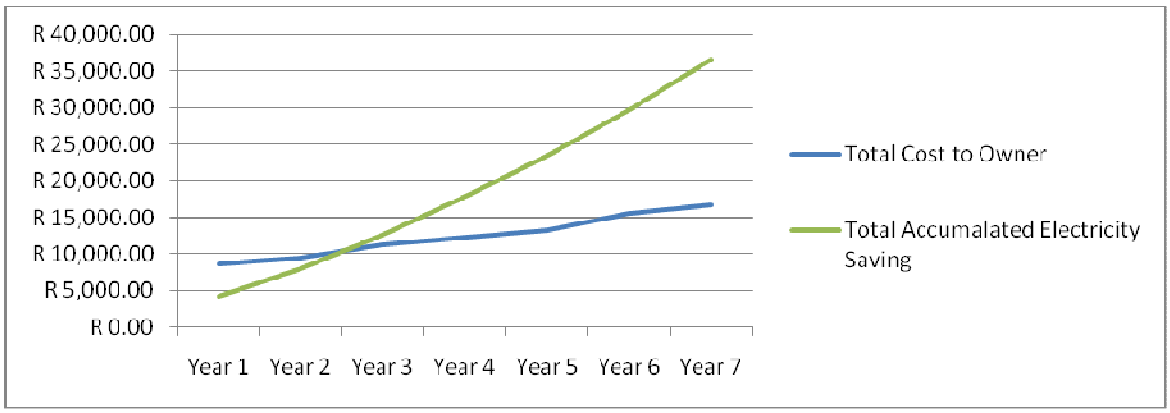


Figure 3.11: Lower end 200ℓ SWH – including SOP, no insurance payout benefit

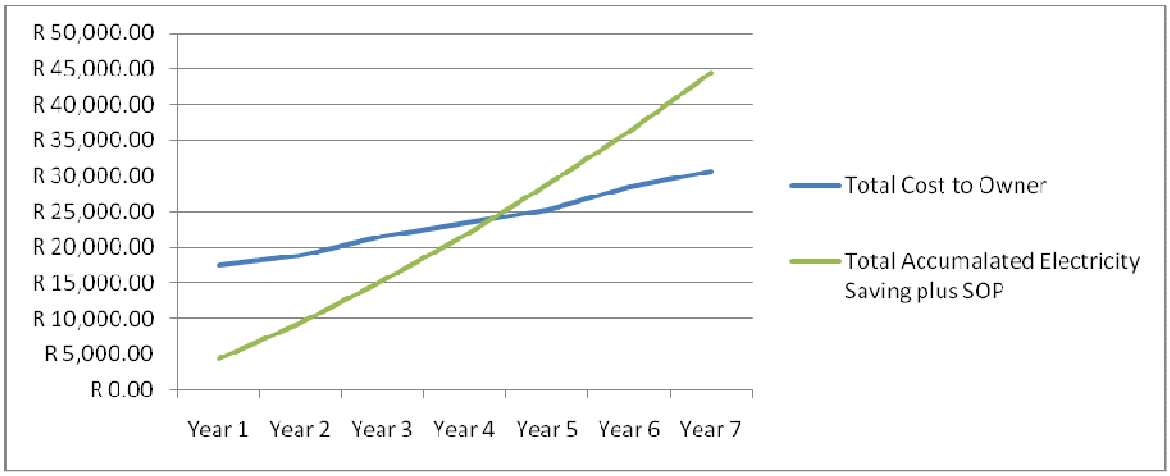
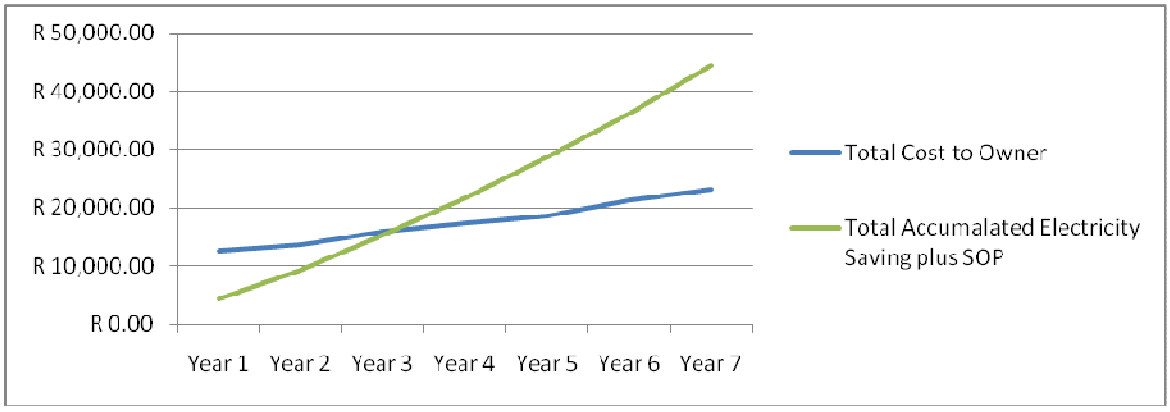


Figure 3.12: Lower end 200ℓ SWH – including SOP, with insurance payout benefit



Appendix 6: Absa SWH Pilot Programme statistics – raw data

Date	Response
14/06/2010	Interested in hearing loan repayment but not serious
17/06/2010	Client wanted solar but decided against it on plumbers arrival
21/26/2010	Doing renovations soon where all changes will be on 1 bond!
22/06/2010	Shortfall too much and wants PRESISE quote first
22/06/2010	Shortfall too much and doesn't want a loan
23/06/2010	Shortfall too much and doesn't want a loan
24/06/2010	Going solar through a cheaper company ' Home Comfort"
24/06/2010	Already replaced with a solar water heater
29/06/2010	Shortfall is too much and he isn't prepared to look at a loan
29/06/2010	Going solar through a cheaper company "Eco Smart"
29/06/2010	Shortfall too much and doesn't want a loan
29/06/2010	Would have considered it for main house but not for granny flat
30/06/2010	Already replaced with electric water heater
30/06/2010	Cant have solar due to thatch roof
01/07/2010	Anna contacted client
05/07/2010	Sent plumber but client turned down our quote for a different company
05/07/2010	On solar plumber inspection- found water heater needs fixing not replacing
08/07/2010	No interest
08/07/2010	Shortfall too much and doesn't want a loan
08/07/2010	Shortfall too much and doesn't want a loan
08/07/2010	Not burst just needing fixing
08/07/2010	Loan declined so client stuck with electrical
08/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Shortfall too much, thinks we should pay for the system
12/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Already replaced with electric water heater
12/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Already replaced with electric water heater
12/07/2010	Already replaced with electric water heater
12/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Irate client who says our systems keep bursting and he must keep paying
12/07/2010	Rules/regulations against solar in his area
12/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Shortfall too much and doesn't want a loan
12/07/2010	Cant wait 3-7 days as house is full of people
13/07/2010	Water heater needed to be changed urgently
13/07/2010	Water heater already being replaced
13/07/2010	Already replaced with electric water heater
13/07/2010	Water heater under GUARANTEE
13/07/2010	Shortfall too much and doesn't want a loan
13/07/2010	Water heater under GUARANTEE
13/07/2010	Shortfall too much and doesn't want a loan
14/07/2010	Already replaced with electric water heater
14/07/2010	Already replaced with electric water heater
14/07/2010	FIRST Solar Installation

Date	Response
14/07/2010	Shortfall too much and cant wait 3-7 days
15/07/2010	Shortfall too much and doesn't want a loan
15/07/2010	On inspection client decided rather to stick with electric & a drip tray
16/07/2010	Shortfall too much and doesn't want a loan
16/07/2010	Shortfall too much and doesn't want a loan
16/07/2010	Already replaced with electric water heater
16/07/2010	Going solar through a cheaper company "Green Power"
16/07/2010	Second Solar Installation
16/07/2010	Shortfall too much and doesn't want a loan
19/07/2010	Water heater under WARRANTEE
19/07/2010	Shortfall too much and doesn't want a loan
19/07/2010	Loan declined , wants payout to go through a different company
19/07/2010	On inspection found clients roof a problem so sticking to electric water heater
20/07/2010	Shortfall too much and doesn't want a loan
20/07/2010	Water heater already being replaced
20/07/2010	Wrong Policy!!!!!
20/07/2010	House in process of being sold
20/07/2010	Already replaced with electric water heater
20/07/2010	Loan department couldn't get hold of client and nor could I
21/07/2010	Shortfall too much and doesn't want a loan and can't wait 3-7 days
21/07/2010	Cant wait 3-7 days as house is full of people and babies
21/07/2010	Shortfall too much and doesn't want a loan
26/07/2010	Shortfall too much and doesn't want a loan
26/07/2010	Water heater under GUARANTEE
26/07/2010	Shortfall too much and doesn't want a loan
27/07/2010	Shortfall too much and doesn't want a loan
27/07/2010	Shortfall too much and doesn't want a loan
27/07/2010	No interest
28/07/2010	Going solar through a cheaper company ' Solatec"
28/07/2010	Shortfall too much and doesn't want a loan
28/07/2010	Water heater under WARRANTEE
29/07/2010	Water heater already being replaced
29/07/2010	Client lives in complex with rules/regulations against solar
29/07/2010	House is being rented out and tenant pays electricity bill
29/07/2010	Shortfall too much and doesn't want a loan
29/07/2010	No interest
29/07/2010	Shortfall too much and doesn't want a loan
29/07/2010	Cant wait 3-7 days
02/08/2010	No interest
02/08/2010	Shortfall too much and doesn't want a loan
02/08/2010	Not needing replacement just fixing
02/08/2010	Shortfall too much and doesn't want a loan
02/08/2010	Shortfall too much and doesn't want a loan
02/08/2010	House is being rented out and tenant pays electricity bill
02/08/2010	No interest
02/08/2010	Already replaced with electric water heater
02/08/2010	No interest
02/08/2010	Shortfall too much and doesn't want a loan
02/08/2010	Water heater under WARRANTEE

Date	Response
03/08/2010	No interest
03/08/2010	Shortfall too much and doesn't want a loan
03/08/2010	House is being rented out and tenant pays electricity bill
03/08/2010	Shortfall too much and doesn't want a loan
03/08/2010	Shortfall too much and doesn't want a loan
04/08/2010	Water heater already being replaced
04/08/2010	Shortfall too much and doesn't want a loan
04/08/2010	Shortfall too much and doesn't want a loan
04/08/2010	Shortfall too much and doesn't want a loan
05/08/2010	Water heater already being replaced
05/08/2010	Shortfall too much and doesn't want a loan
05/08/2010	No interest
05/08/2010	House is in process of being sold
06/08/2010	Already replaced with electric water heater
06/08/2010	Wants info before making a decision
06/08/2010	Water heater under GUARANTEE
06/08/2010	Shortfall too much and client want info to study
09/08/2010	Water heater still under GUARANTEE
10/08/2010	Shortfall too much and doesn't want a loan
10/08/2010	No interest
10/08/2010	Shortfall too much and doesn't want a loan
10/08/2010	Water heater already being replaced
10/08/2010	Water heater already being replaced
10/08/2010	Already replaced with electric water heater
10/08/2010	Shortfall too much and don't want a loan
10/08/2010	Shortfall is too much and he isn't prepared to look at a loan
10/08/2010	Shortfall is too much and can't get a loan due to existing bond in a rears
11/08/2010	No interest
11/08/2010	Shortfall is too much and don't want a loan
11/08/2010	Water heater under GUARANTEE
11/08/2010	Shortfall is too much and he isn't prepared to look at a loan
11/08/2010	Shortfall is too much and he isn't prepared to look at a loan
11/08/2010	Can't get hold of client so claim is being unattended for way too long!
11/08/2010	House is in process of being sold
12/08/2010	Can't afford shortfall and can't get a bond due to 2 bonds busy being paid
12/08/2010	Researched solar and it is not suggested for her area(mountains)
12/08/2010	Loan application declined, sticking to electrical
12/08/2010	Client uses too little water monthly for solar to pay off
12/08/2010	Shortfall is too much and he isn't prepared to look at a loan
12/08/2010	Can't wait 3-7 days
12/08/2010	Sticking to electricity just reconnecting to her solar panels
13/08/2010	Wants to get her existing solar water heater fixed
13/08/2010	Water heater already being replaced
16/08/2010	Water heater already has a timer so they are already saving
16/08/2010	Already replaced with electric water heater
16/08/2010	Shortfall is too much and he isn't prepared to look at a loan
16/08/2010	Shortfall is too much and he isn't prepared to look at a loan
16/08/2010	No interest
16/08/2010	Water heater needs replacing asap as it is affecting her electricity too

Date	Response
16/08/2010	House is being rented out and tenant pays electricity bill
17/08/2010	Shortfall is too much and he isn't prepared to look at a loan
17/08/2010	Shortfall is too much and his roof is a problem
17/08/2010	Shortfall is too much and he isn't prepared to look at a loan
17/08/2010	Water heater already being replaced
17/08/2010	Client won't even consider it before information is sent to him
18/08/2010	No interest
18/08/2010	Shortfall is too much and he isn't prepared to look at a loan
19/08/2010	No interest
19/08/2010	Uses minimal amounts of water
20/08/2010	Shortfall is too much and he isn't prepared to look at a loan

Source: (de Ridder 2010b)

Appendix 7: Anecdotal personal SWH stories

Martin Kaplan, Durban

"In April or May 2007 the old water heater in my roof sprang a leak. I contacted the plumber who reminded me to claim against my homeowners policy (Santam Limited through Investec Insurance Brokers). I had been toying with the idea of switching to solar and this seemed the ideal opportunity - with the insurance pay-out being an added incentive. So I approached my brokers, who contacted my insurers. I was quite surprised - it would be no problem at all! The insurance policy would pay me the equivalent cost of an electrical water heater and I could use the funds for the system I chose. It seemed they actually liked the idea!

I contacted Solar Beam who I had dealt with on solar installations at rural clinics in KwaZulu-Natal in the late 1980's. They quoted me R15,500.00 (incl.) for a 300 litre close coupled system and told me about a UN subsidy scheme which would contribute R5,000.00 towards this cost. We did well to change and have enjoyed years of sun heated water with *very* occasional electrical back-up (this is Durban after all!) ever since."

(Kaplan 2010)

Henk Smith, Cape Town

"I did some renovations to my home in 2009 and amongst other things, added a new bathroom. I had a SWH installed for this new bathroom and applied for the Eskom subsidy. I was quite disappointed when I read in January 2010 that the SWH subsidy had doubled and wondered whether I would qualify for the higher subsidy, as I had not yet received any money back.

In September 2010, I have still not received my subsidy. I do not know why this is. I have mislaid the paper work and have not followed up on the claim."

(Smit 2010)

Ralph Pina, Stellenbosch:

"I installed an Israeli system, panel collector, thermo-siphon, external, integrated unit in 1996 (think it cost R7k back then). I had to have a tank leak fixed once. It's been operating pretty much without outage since then. From Sep to April it provides almost continuous hot water. With it my peak energy usage per day in winter was 21 kWh and in summer down to about 11 kWh. Since installing a Geyserwise timer, the max in winter was 19 kWh and in summer I regularly get down to

10 kWh. In August 2010, it was already down to 12 kWh for the month. In the week of 13 September 2010, the tank temperature got up to 63 ºC. The max I have seen was 82 ºC.

From watching the temp readout I realise that it loses a lot of heat in winter especially, so only heating water when you need it saves significant power."
(Pina 2010)

Caron Schmidt, Cape Town:
"It was around April-May that we had a burst water heater (150ℓ), and once the insurance company had sent out a plumber to evaluate they realised that it was still under guarantee and contacted Kwikot directly.

Kwikot informed me that I couldn't have a solar water heater as a replacement as it was approx. R10 000 more to replace.

They then replaced our water heater with another water heater that I assume was identical.
We have another water heater in our guest room with a capacity of 100ℓ but it isn't in use as the pressure valve needs replacing and some other issues need sorting out. The plumber quoted me around R3 000 for the work involved."
(Schmidt 2010)

Valerie Payn, Harding, KZN:
"We bought a SWH at the beginning of August 2008. We haven't yet had it installed for a complex number of reasons, including that the person who sold it to us and who said he would install it has not gotten back to us, and we haven't done enough 'nagging' of him to get it done, that we haven't been able to find anybody else qualified to do it if we want to claim the rebate, and that we have (my husband and myself) both just been too busy to spend the time necessary to organise / look into the whole business of installing it etc.

We bought it for environmental reasons (to cut our carbon emissions), but also for economic reasons (to cut our electricity bill) and also for practical reasons (we don't have a water heater big enough to give everyone hot water when the house is full and everyone wants to bath / shower at once) so we thought this could give extra hot water holding capacity to our water heater. Also that at least we would be able to get some hot water on days when ESKOM power is down."
(Payn 2010a)

Karin Kritzinger, Somerset West.

In February 2010, our electricity supply started to trip. We isolated the problem to the water heater. The landlady was called and she called the plumber. He arrived the same day and said that the water heater had burst. He quoted R8 650 to replace. He informed us that this should be covered by the insurance.

My landlady agreed that it would be great to replace with a SWH. Helmut Hertzog from Atlantic Solar was called and he arrived the next day. After investigation, he informed us that it was merely the thermostat which was broken. He summarily replaced it. The cost of the replacement was under R200.
(Kritzinger 2010)

Tessa West, Somerset West

"Since building our house in 1995, we have had to replace the water heater twice. The first water heater broke in 2002, after we noticed a rusty colour in the water, this was an Everlast make. It was then replaced by a Kwikot, which later burst in 2007, and was replaced by the same Kwikot model.

In both cases we contacted Santam insurance and they sent out a plumber to look at the damage and fix the problem. Both times they replaced the water heater and repaired the ceiling where it was damaged by water. No other damage was caused by the water. On both occasions the water heater was fixed very quickly (the same day, or maybe the next, I cannot quite remember)."
(West 2010)

Gill Hamilton, Johannesburg

"In March 2010, while I was in Cape Town, we had a lot of water running from the ceiling. We assumed it to be a burst water heater. We got the plumber around and it turned out that it was a burst pipe and not the water heater. Two weeks later, we still had not had anyone from the insurance coming to check the situation out so I think that I would have been livid by then if we did have a water heater problem.

We had decided to replace with a SWH and when we found out that it was not in fact the water heater that had burst, we decided to install a SWH anyway.

What was interesting is that the solar companies were so busy that it took them weeks to come and install – after confirming the order and paying the deposit, it still took another two weeks to install. This probably does not bode well for the industry."
(Hamilton 2010)

Phillip Ravenscroft, Stellenbosch:
"A couple of years ago (November 2007) our water heater at home burst. We were at home, there was no major damage and we did not bother with getting insurance to pay for a replacement. I took it as an opportunity to replace the water heater with a solar water heater but did not get the solar panel installed at the same time as I had limited time available for research at the time. I looked at the Solardome, Sonpower and Kwikhot water heaters and eventually I went with the Kwikhot based on a balance of price and reliability (based on discussion with a couple of people I thought knew better than I).

Last year, after hearing Helmut Hertzog speak at a workshop at Stellenbosch Institute for Advanced Study (STIAS), I approached Altantic Solar to install the panel. We have a flattish pitched roof and in the end went for a system with a panel, pump driven by PV and a GeyserWise max controller. Because our water heater and panel are at the same level, we had some problems with water circulating when it should not. Initially this was circulating backwards at night (I think). A U-shaped tube was installed on the pipework between the water heater and the panel to break the thermosiphon and it was an improvement.

Our system does still not operate perfectly and I do need to speak with Atlantic Solar to see how they can assist (I have copied this to Helmut). At the moment it is still operating on electricity primarily (because of lack of sun) and we have it set to go on for a 2hr period in the early morning and late afternoon. When one uses hot water (for one shower for example) the water temperature in the water heater drops dramatically (say from 53 to 33). If you use it again immediately it is actually still hot but if you leave it for a while the water really is quite cold. IE we are getting a fraction of the 150l of the water from the water heater.

Monitoring the Geyserwise Max I have noticed that the pump is switching on once one starts to use hot water even though the water in the water heater is hotter than outside (at night for eg).
The controller also malfunctions regularly giving an E9 error but this does not seem to affect the performance significantly."
(Ravenscroft 2010)

Bo Duvenhage, Cape Town:

"We moved into a rented house on 1 July 2010. The house has a SWH. I tried once to turn the SWH Eskom supply off and it resulted in no hot water available the next morning. We had used the hot water the night before. The conclusion here for me is to either manage the ESKOM supply through a timer so that it uses ESKOM at night for 3 hours or to adapt our lifestyle and not bath in the morning and the evening, but rather only one of the 2 times. The shutting off of ESKOM power during the day probably doesn't make a difference as the solar panel takes over even if ESKOM power is connected.

There is no timer on the SWH, just a switch to connect or disconnect Eskom. I presume that when the ESKOM switch is on that it means the SWH is being powered by ESKOM as well as the Solar panel. The tank is inside the roof and the panel is outside on the roof."
(Duvenhage 2010)

Doret Ferreira, Cape Town:

"I have been investigating the possibility of installing a SWH for quite some time. Looking at the ESKOM subsidies, service providers, different options etc. When my water heater burst and I had to replace it however, it did not occur to me that this was the opportunity to make the switch. I contacted my homeowners insurance and followed their instructions to replace the water heater without making the connection - I just wanted to get it all sorted out as quickly as possible."
(Ferreira 2010)